Obesity Trends for Children Aged 2-11

Analysis from the Health Survey for England

1993 – 2007

Report by the National Heart Forum

Martin Brown, Tom Byatt, Tim Marsh, Klim McPherson

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1 Executive summary

The publication of the Foresight report Tackling Obesities in 2007[i], generated a significant amount of interest both from within the UK and Internationally. The use of micro-simulation modeling to predict future trends and their consequences in obesity developed by the National Heart Forum attracted particular interest. The Governments response to the Foresight report was to launch perhaps the most comprehensive national strategy to tackle obesity anywhere in the western world, Healthy Weight Healthy Lives (HWHL) and the establishment of a new public service agreement: *of being the first major country to reverse the rising tide of obesity and overweight in the population by ensuring that all individuals are able to maintain a healthy weight. Our initial focus is on children: by 2020 we will have reduced the proportion of overweight and obese children to 2000 levels.*

The ongoing obesity crisis will continue to present challenges to policy makers as to the best ways to address the rise in numbers of those overweight and obese, particularly amongst children. To support these challenges policy makers require constant timely advice on both trends in the short and longer term and their impacts on associated diseases and the indirect and direct economic costs. The time lag in the availability of data means that the data used in producing the Foresight report was derived only from the years 1993 to 2004. The NHF modeling team, are now able to analyse trends based on another three years data - up to and including 2007. It is too early to show any impact from HWHL strategy which began in 2007 but these are a good indicator of the direction of travel of the trends.

The larger data set, 1993 to 2007, obviously allows direct comparisons with the Foresight predictions but, importantly, it allows an examination of the possibility of changing trends over the period 1993 to 2007. This report examines trends based, in part, on the two halves of the data set the years [1993 to 2000] and the years [2000-2007].

By simply incorporating the recent Health Survey for England (HSE) data into the Heart Forum model, it is shown that for children of both sexes, aged 2 to 11, the predicted prevalence of overweight and obese in 2020 drop from their Foresight predicted values of 28% overweight and 16% obese to 22% overweight and 12% obese. Since the review of obesity predictions in 2005[ii], the 2006 data showed a small reduction in obesity levels and the 2007 data have tended to confirm this decrease. Similar reductions in the predicted prevalence at 2020 are recorded for the 12-19 age group although there are some interesting differences between the sexes.

In all, results are presented for four different sets of data: the Foresight years [1993-2004], all years [1993 to 2007]; the early years [1993-2000]; the most recent years [2000-2007]. The last two sets allow a comparison of how trends have changed from the first half of the data set to the last half. The results for the under 20s are presented in detail. In order to provide context, results for adults are presented showing that for all ten year age groups under 70 and for both sexes individually the predicted rate of growth in the prevalence of overweight and obese is less, and sometimes much less, for the more recent data set. In this sense, the rate of growth of the prevalence of obesity may be said to be slowing down. For some age groups, particularly males age 11-20 and 21-30, the predicted prevalence of obesity is actually falling.

2 Introduction

The publication of the Foresight report, Tackling Obesities in 2007, generated a significant amount of interest both from within the UK and Internationally. The micro-simulation model to predict future trends and their consequences in obesity developed by the National Heart Forum has attracted particular interest.

The National Heart Forum has continued to refine the obesity micro-simulation in the years following the publication of the report so that it now includes

1. Improving the obesity distributions for monitoring changes in obesity with time systematically (in collaboration with the obesity observatory) and for honing down on demographic effect modifiers (or lack of) more systematically, e.g. by age, sex, class and geographical region and their trajectories.

2. Beginning to incorporate hypertension and also quality of life in the economic component, significantly, enhancing this component of the program. To begin to tease out the relative costs (including Quality of Life) of overweight compared with obesity.

3. Improving the general usability of both the obesity distribution and micro-simulation programs.

We have also improved the utility of the obesity distribution program and make it capable of processing alternative data sources (for example, international data) the program has been provided with new front end. It now has the ability to analyse complex stratified, multi-PSU (Primary Sampling Unit), data surveys. These changes mean that new data from the National Child Measurement survey could be incorporated into the existing England model and highlight progress towards the Governments PSA target on childhood obesity.

The micro-simulation has also been significantly upgraded so that users can easily specify relevant national data bases that may differ from year to year or from one country to another. This has required the provision of:
a disease editor allowing the input, editing and logging of disease statistics.
a general statistics editor allowing for the user-specification of population distributions, birth and death statistics and so on.
an economic cost editor enabling easy changes to be made to the economic costs in the model.

The current and likely ongoing obesity crisis will continue to present challenges to policy makers as to the best ways to address the rise in numbers particularly amongst children. To support this, policy makers will require constant timely advice on both trends in the short and longer term and their impacts on associated diseases and the indirect and direct economic costs.

2.1 Scope

To process the new HSE datasets as they become available, in this case 2007, and incorporate them into the software developed for Foresight to show trends until 2020, by gender, age, social class etc. The analysis of these new data are divided into two reports, this and its earlier companion.

2.2 Organisation of this report

The report is divided into a number of sections.

Section 3 describes the background to this report and comments briefly on those features of the data processing that are necessary for an understanding of the main content of the report.

Section 4 reports on the analysis of the HSE data from 1993 up to and including the most recent data set, that for 2007, which was released in March 2009. Almost all measures used for comparison are predictions from subsets of these data for the year 2020. This section deals exclusively with children aged 2-11 undifferentiated by sex. It contrasts the predictions to 2020 for theUK90 and OTF classifications of child obesity.

Section 5 reports on predictions for the age groups 2-11 and 12-19 now differentiated by sex. Results are again given for both the UK90 and OTF obesity classifications.

Section 6 draws relevant conclusions.

3 Background

3.1 Data processing

Processing is essentially the same as for the original Foresight report. It is carried out by the purpose built C++ program Obesity_distribution.exe.

Each year relevant data are drawn from the The Health Survey for England (HSE) published data files and are sorted by age, sex and BMI group.

The program Obesity_distribution sorts HSE files to obtain estimates for the proportion of the sampled population that (for example) belong to a particular age group, sex group and BMIgroup. These annual estimates are variously termed *plots* or *data points* and consist of three components: the year for which the data are valid, the proportion or percentage of the population in that year and the standard deviation of the proportion of the population in that year.

Trends for particular age-sex-BMI subgroups are obtained by performing regression analysis on collections of data points drawn from a number of years. For example, figure 1. draws the three sets of 13 plots for the 2-11 age group that is divided into the three UK90ok, UK90ow and UK90ob BMI-subgroups.

In Figure 1 the short, solid vertical lines show the data points: for each year for which data are available (in the case of Figure 1, 1995 to 2007). The centre of these lines is the best estimate for the proportion of the population; the vertical lines are drawn to show $\pm$ 2 standard deviations either side of the best estimate.

The solid trend lines are the two (two-parameter) regression lines that are calculated by standard Bayesian, maximum likelihood analysis from the sets of plots.

The maximum likelihood estimates of the regression parameters and their probability distributions are determined by standard analysis from the relevant set of plots. The probability distribution of the parameters is used to determine the confidence limits for the regression line – these are shown as dotted lines – with the associated confidence region being shaded.

The program Obesity_distribution can perform a similar regression analysis for any selected subset of plots and this feature is exploited in this report.

3.2 UK90and IOTF BMI groupings

For adults of all ages over 18 it is widely accepted that the BMI values of 25 and 30 are the cut points dividing the population into normal weight, overweight and obese. The classification of children as overweight or obese is more complicated and the relevant cut-points of BMI are age dependent. This report makes reference to two distinct but similar classifications of overweight and obese [iii]: The UK90and International Obesity Task Force (OTF) classifications[iv]. For each classification there are three exhaustive groups labelled UK90ok, UK90ow, UK90ob and OTFok, OTFow, OTFob identifying the normal weight, overweight and obese groups respectively. For ages less than 18 the age and sex dependent cut points and are listed in Table 1 and Table 8 for the UK90 and OTF classifications respectively; ages greater than 18 have cut points the same as those for 18.

4 Trend analysis

Looking at data points year by year it is difficult to draw conclusions as to the general state of the obesity epidemic. Consecutive years comparisons will only show significant changes, even in the presence of a change in trend, which tends to be more gradual. It appears to be

the case that the last two years of data do indicate a slowing in the rise of national obesity levels but one can find other years in the recent past where a pair of data points appear inconsistent with a perceived trend. This may also be a consequence of the increase in sample size in recent years. It is only by looking at significant numbers of data points together and their computed trends that one can form any reliable indicators of what might be happening to obesity levels post 2007. This section computes and examines these trends.

The data presented here are derived from HSE surveys for the years 1993 to 2007 inclusive. These data show a similar general pattern: the rate of increase in the percentage of overweight and obese for the first half of the data [1993 to 2000] is significantly higher than the same rate as determined by the last half of the data [2000 to 20007]. In this sense, loosely stated, *the rate of increase in obesity levels is slowing down*. The details are interesting: for combined sexes they are given in this section; the trends differentiated by sex are presented section5.

4.1 Trends for UK90distributions for children aged 2-11

At the time of the Foresight report, appropriate HSE data sets existed from 1993 to 2004 inclusive. By the time of writing of this report three more years have been added: 2005, 2006 and 2007. Figure 1 shows the predicted UK90 distribution for 2-11 year old children that is based on the complete set of data points 1995 to 2007 inclusive[1]. The figure shows the prediction for the population's membership of the three UK90subclasses UK90ok and UK90ow and UK90ob to the year 2020. The 95% confidence limits are shown as the shaded regions.

Figure 2 is identical to figure 1 excepting only that it makes its predictions using those data that were available at the time of the Foresight report – the years [1995-2004].

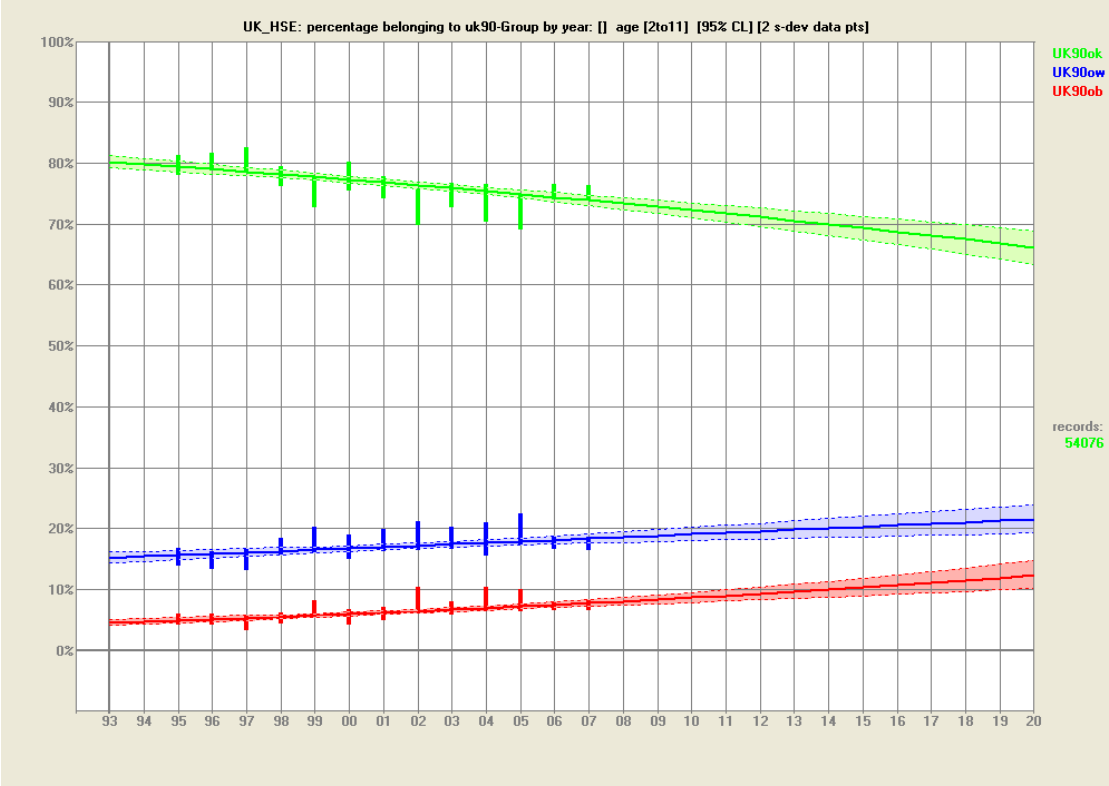

Figure 1: Male & Female aged 2-11, predicted UK90 membership to 2020 for data years 1995 to 2007 inclusive

[1] Data for young children (less than 16) has been collected only since 1995.

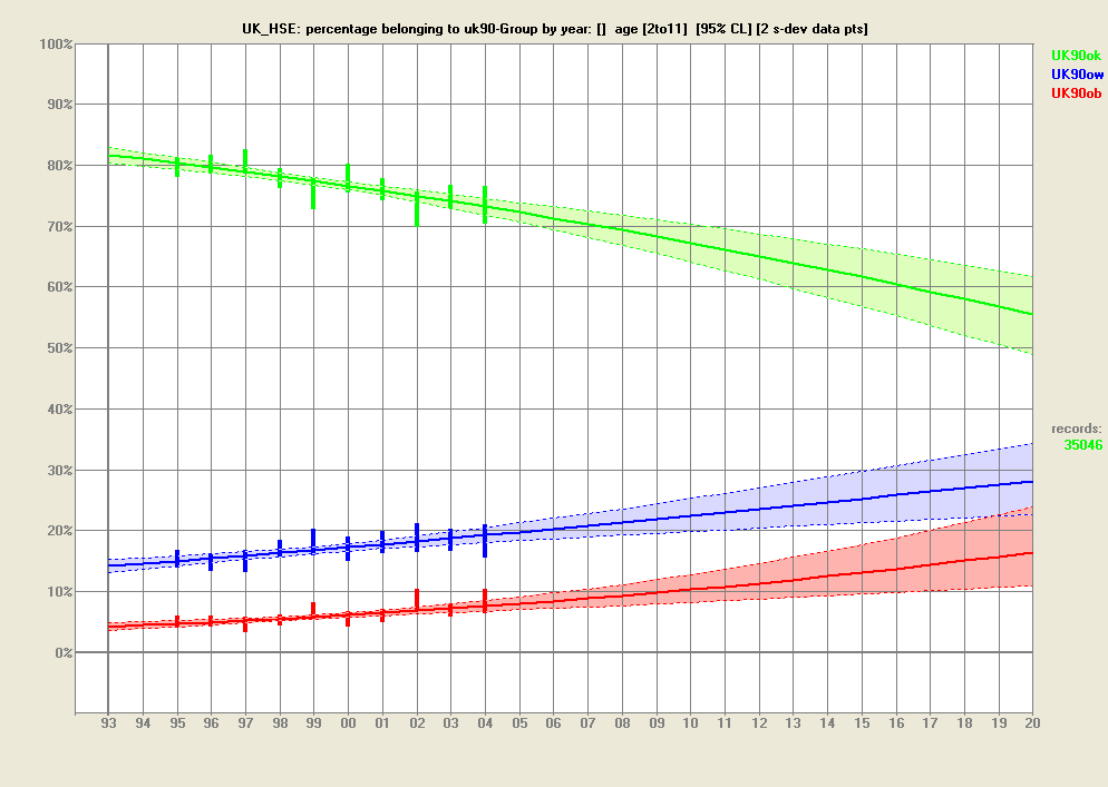

Figure 2: Male & Female aged 2-11, predicted UK90 membership to 2020 for data years 1995 to 2004 inclusive – the Foresight prediction

As time moves on and more data are accumulated, the key question is whether or not the increase in the overweight and obese section of the population demonstrated in the original Foresight report is continuing. This analysis would suggest that there is a reduction in the rate of increase - the most recent data [2006 and 2007] have reduced the expected proportion of young children who will be obese or overweight in future years by the year 2020; a 6% drop in overweight [28% to 22%] and a 4% drop in obesity [16% to 12%].

But there is a subsidiary question that has yet to be answered, namely: How many data points should be used in identifying the recent trend? This question is particularly relevant when the data points span a period over which the trend appears to be changing. In particular, should the early data points, 1993, 1994….continue to influence predictions of the population from 2008 onwards? The answer to this last question, we believe, is probably not.

Looking at a large number of graphs similar to those above but for different age groups, there does appear to be an emerging pattern in which, roughly speaking, the years 1993 to 2000 showed strong growth in obesity while in the more recent years, 2000 to 2007, that growth has slowed and in some cases become negative. Consider two more graphs:

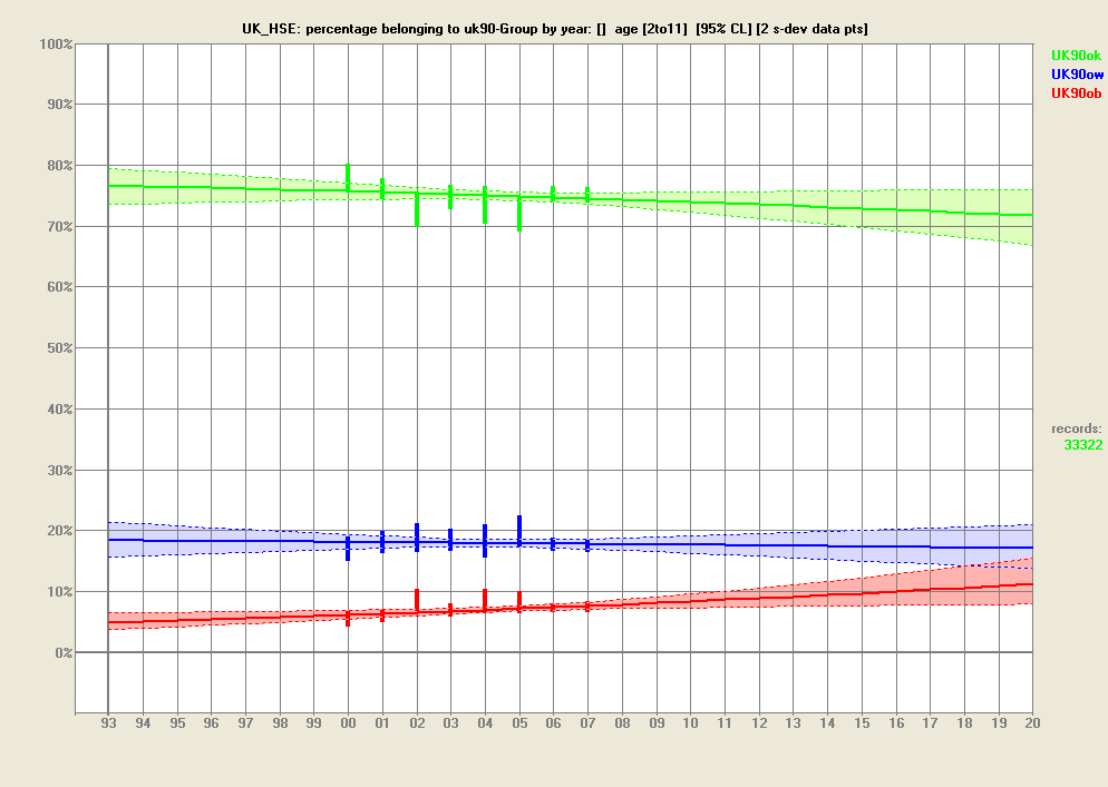

Figure 3: Male & Female aged 2-11, predicted UK90 membership to 2020 for data years 2000 to 2007 inclusive

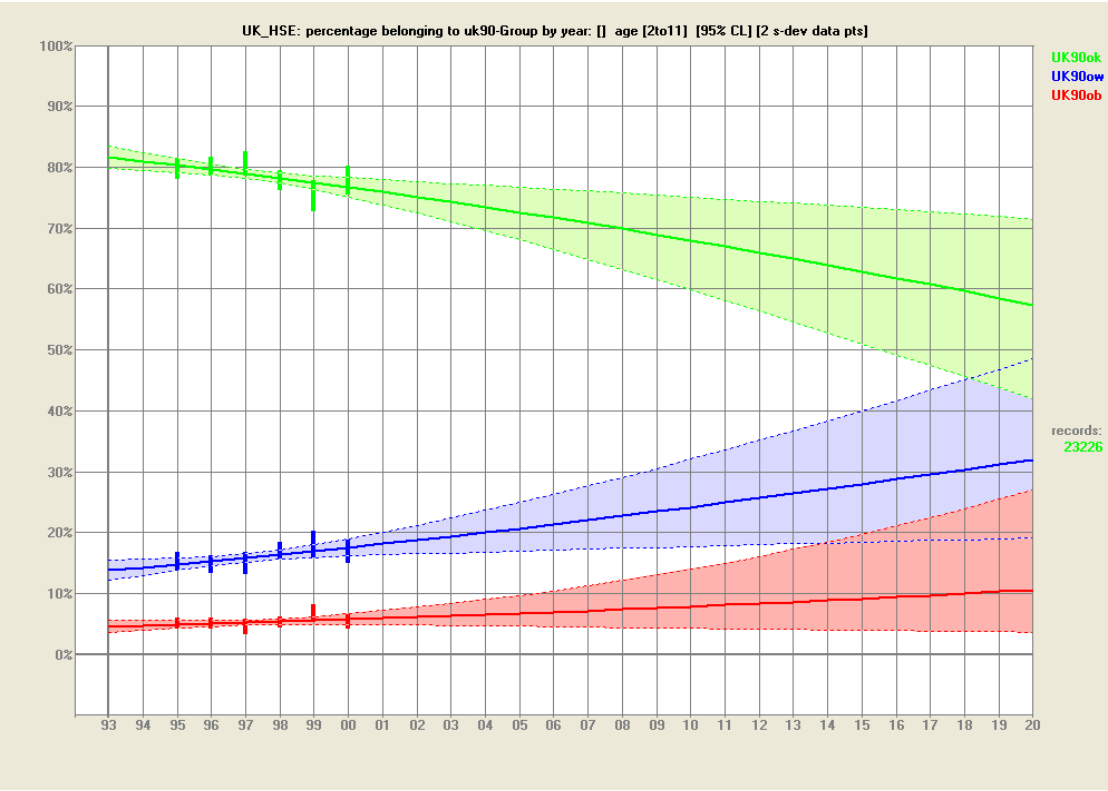

Figure 4: Male & Female aged 2-11, predicted UK90 membership to 2020 for data years 1995 to 2000 inclusive

Figure 3 [the trend for the last eight years only] has a falling proportion of overweight and with the rate of growth of the obese group being slower than the Foresight prediction.

Figure 4 [the trend for the years 1995 to 2000] is similar to the Foresight prediction but with noticeably larger 95%-confidence regions resulting from using fewer, and more distant, data points.

These two sets of graphs present a mixed picture: for the overweight group the trend as determined by the last eight years is significantly different from the trend of the first six years; the obese group have similar trends for the two data sets. The net effect is to alter favorably the trends for the normal weight group.
The results for these first four graphs are summarized in table 1 that gives the predicted UK90 distribution in the year 2020 as calculated from four different sets of data points. [The numbers in each column should add to 100, any discrepancies are due to rounding errors]:

predictions to 2020	Foresight [1993-2004]	All years [1993-2007]	first 8 years [1993-2000]	last 8 years [2000-2007]
UK90ok				
2to11	55	66	57	72
UK90ow				
2to11	28	22	32	17
UK90ob				
2to11	16	12	11	11

Table1: Male & Female aged 2-11, predicted UK90 distributions at 2020

The analogous table for the OTF BMI classification is given by table 2.

In this report we shall continue to provide predictions, for 2020 mainly, that make use of the four different sets of data points: the Foresight years [1993 to 2004]; all years [1993 to 2007]; the first eight years [1993 to 2000]; the last eight years [2000 to 2007]. Each set of data points is included for a different reason:

The Foresight years [1993 to 2004]: to provide a necessary reference.
All years [1993 to 2007]: to provide continuity and a comparison with Foresight.
The first eight years [1993 to 2000]: to compare early trends with most recent trends.
The last eight years [2000 to 2007]: the best estimate of the most recent trends.

4.2 Trends for OTF distributions for children aged 2-11

This section simply reproduces the analysis of section 4.1 using the IOTF obesity classification in place of the UK90 classification.

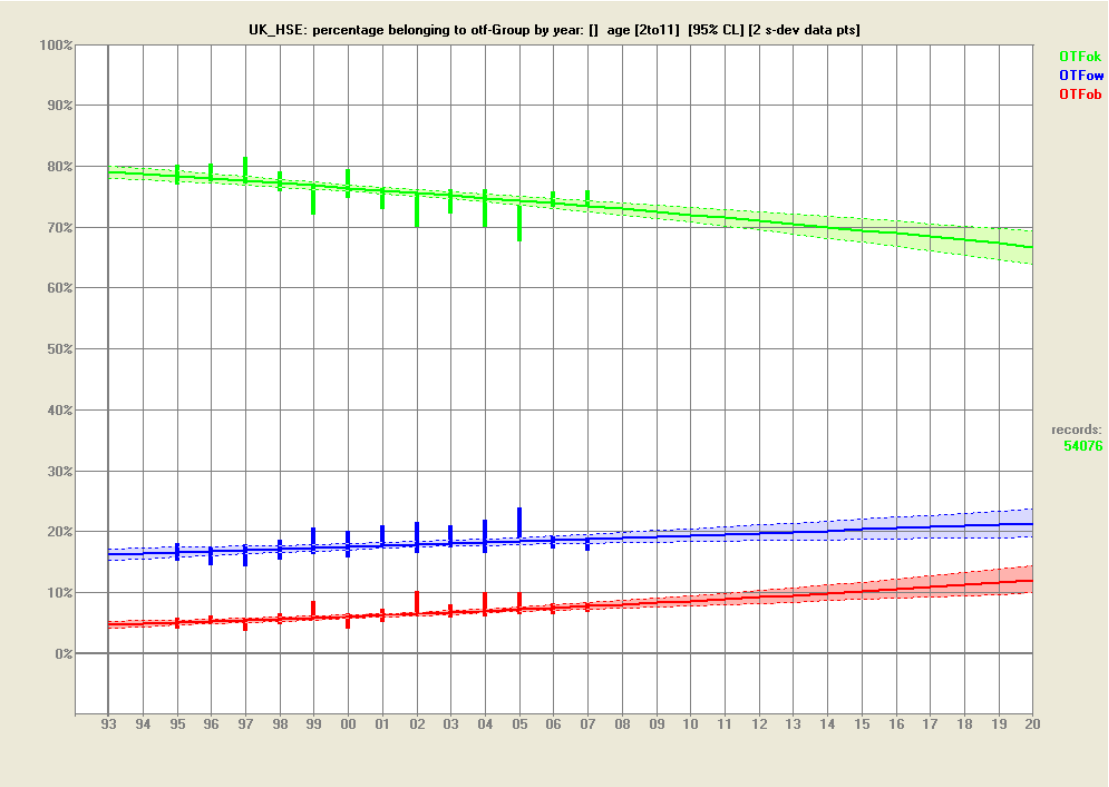

Figure 5: Male & Female aged 2-11, predicted IOTF membership to 2020 for data years 1995 to 2007 inclusive

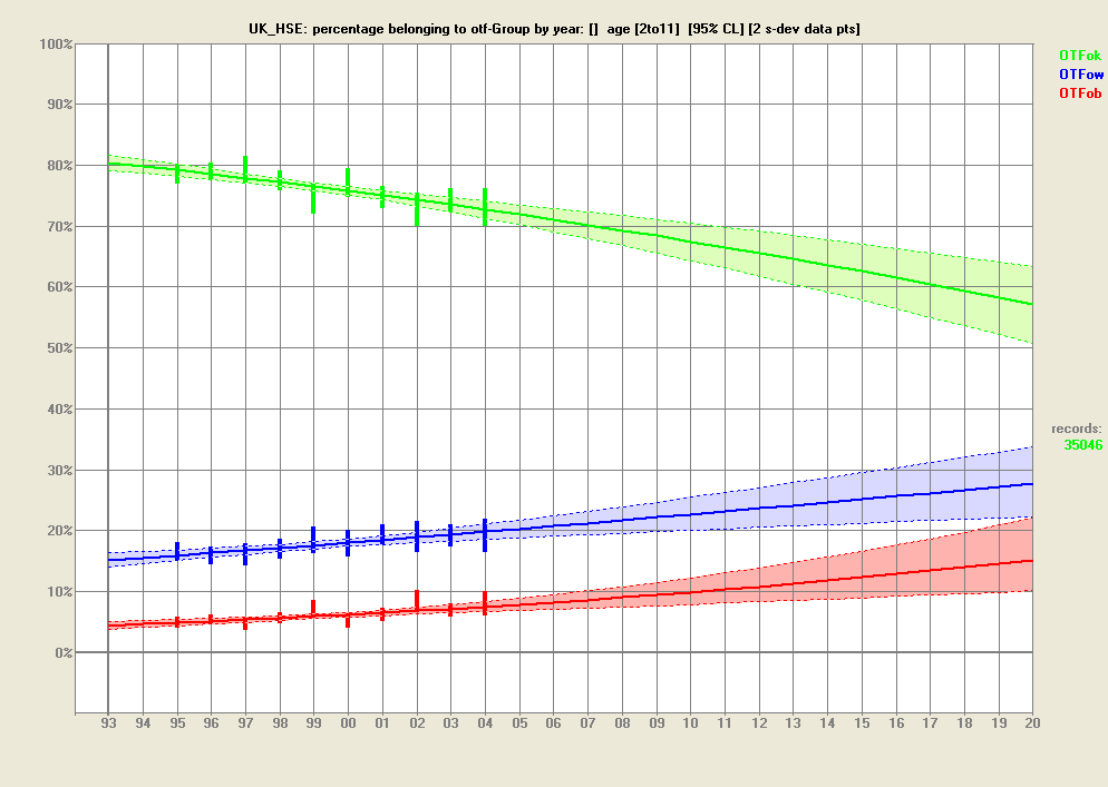

Figure 6: Male & Female aged 2-11, predicted IOTF membership to 2020 for data years 1995 to 2004 inclusive

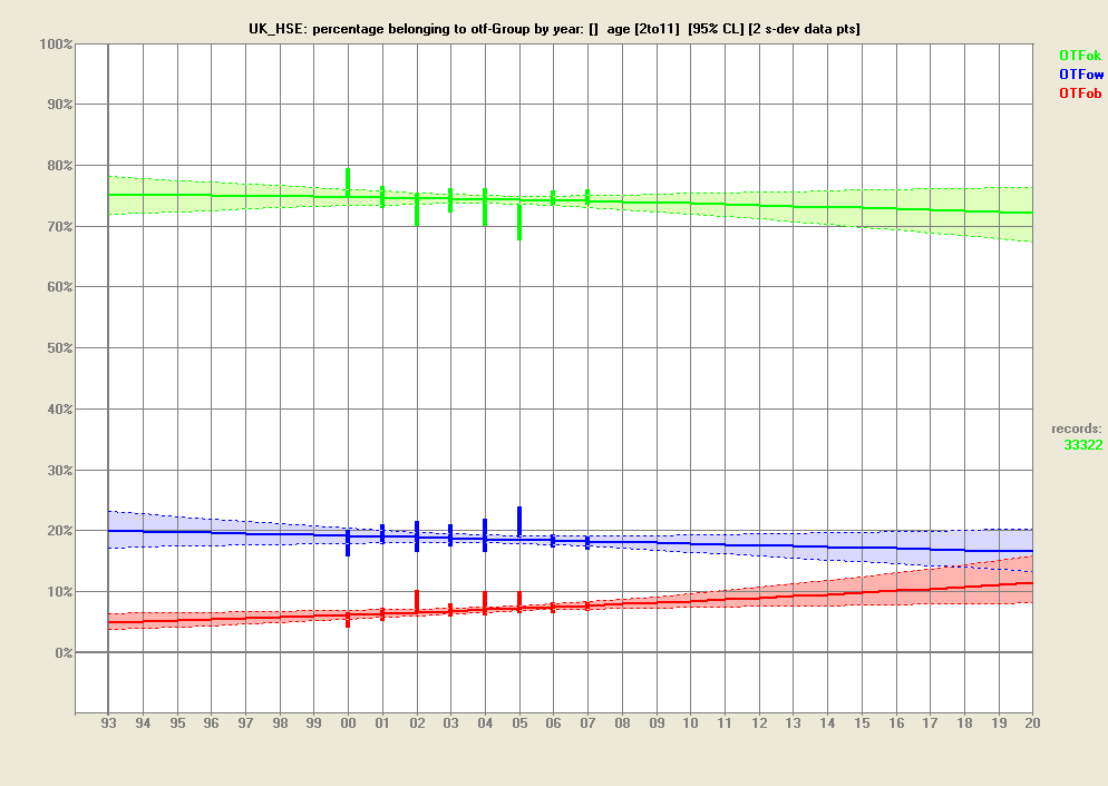

Figure 7: Male & Female aged 2-11, predicted IOTF membership to 2020 for data years 2000 to 2007 inclusive

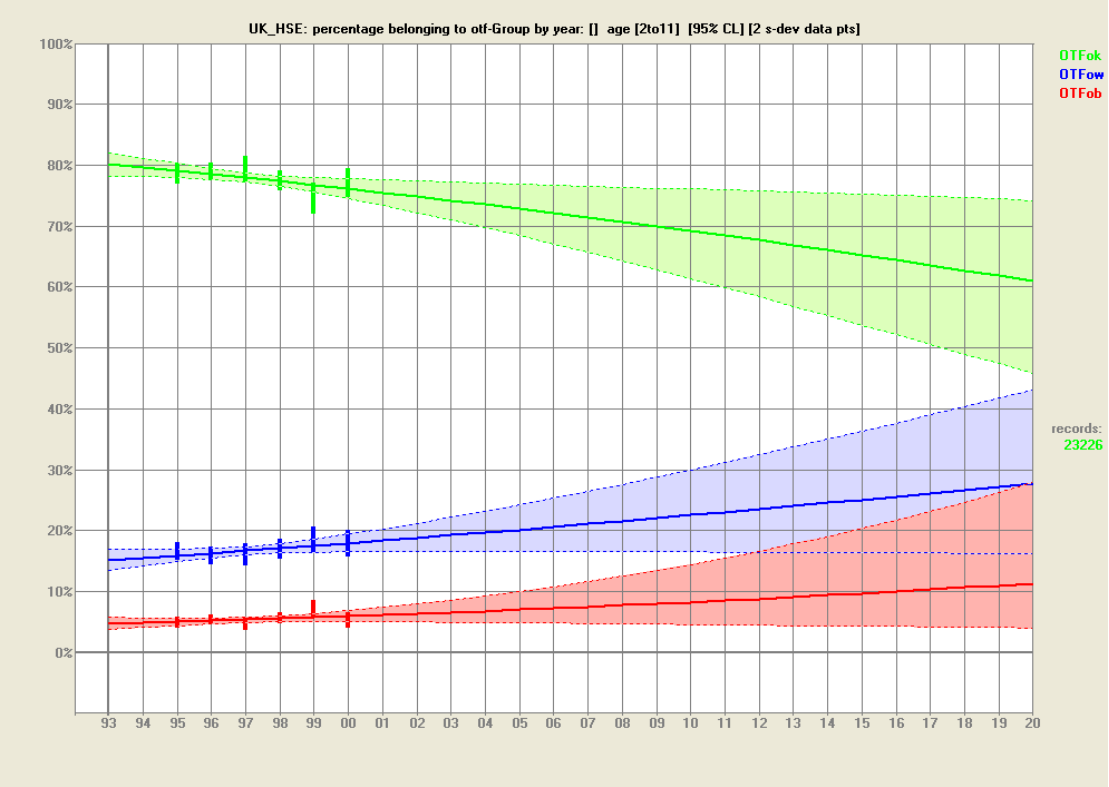

Figure 8: Male & Female aged 2-11, predicted IOTF membership to 2020 for data years 1995 to 2000 inclusive

predictions to 2020	Foresight [1993-2004]	All years [1993-2007]	first 8 years [1993-2000]	last 8 years [2000-2007]
OTFok				
2to11	57	67	61	72
OTFow				
2to11	28	21	28	17
OTFob				
2to11	15	12	11	11

Table 2: Male & Female aged 2-11, predicted OTF distributions at 2020

The trend from 2000-2007 data for the OTF obese group is significantly lowered from its Foresight value predicting 11% obese against 15% for Foresight.

5 Trend analysis for boys and girls separately in the age groups 2-11 and 12-19

This section summarizes results for the predicted UK90 and OTF distributions by sex for the two age groups 2-11 and 12-19. Any group having a prediction for the percentage of obese or overweight that is lower than the level in the year 2000 is highlighted in green. The sets of detailed graphs that accompany these tables can be found in Appendix B. These tables themselves are summarized by the histograms shown in Figures 9-13.

predictions to 2020	Foresight [1993-2004]	All years [1993-2007]	first 8 years [1993-2000]	last 8 years [2000-2007]
UK90ok				
2to11,male	57	67	54	70
2to11,female	52	65	58	72
UK90ow				
2to11,male	22	19	33	17
2to11,female	34	24	31	17
UK90ob				
2to11,male	20	14	13	13
2to11,female	14	11	11	10

Table 3: Children aged 2-11, predicted UK90 distributions at 2020 by sex

predictions to 2020	Foresight [1993-2004]	All years [1993-2007]	first 8 years [1993-2000]	last 8 years [2000-2007]
UK90ok				
12to19,male	56	68	68	76
12to19,female	35	49	36	62
UK90ow				
12to19,male	25	20	14	18
12to19,female	35	34	37	29
UK90ob				
12to19,male	19	12	18	6
12to19,female	30	17	27	9

Table4: Children aged 12-19, predicted UK90 distributions at 2020 by sex

predictions to 2020	Foresight [1993-2004]	All years [1993-2007]	first 8 years [1993-2000]	last 8 years [2000-2007]
OTFok				
2to11,male	56	66	56	70
2to11,female	57	67	65	73
OTFow				
2to11,male	23	20	31	16
2to11,female	33	23	24	17
OTFob				
2to11,male	21	15	13	14
2to11,female	11	10	11	10

Table 5: Children aged 2-11, predicted OTF distributions at 2020 by sex

predictions to 2020	Foresight [1993-2004]	All years [1993-2007]	first 8 years [1993-2000]	last 8 years [2000-2007]
OTFok				
12to19,male	58	71	76	78
12to19,female	37	53	43	66
OTFow				
12to19,male	24	20	14	18
12to19,female	35	32	34	27
OTFob				
12to19,male	18	9	9	4
12to19,female	28	15	24	7

Table 6: Children aged 12-19, predicted OTF distributions at 2020 by sex

The 24 separate graphs that are summarized in these tables are listed in the following subsections.

6 Conclusions

Conclusions are given first for the age group 2-11 where the sexes are combined and then in more detail.

6.1 Boys and girls aged 2-11 combined

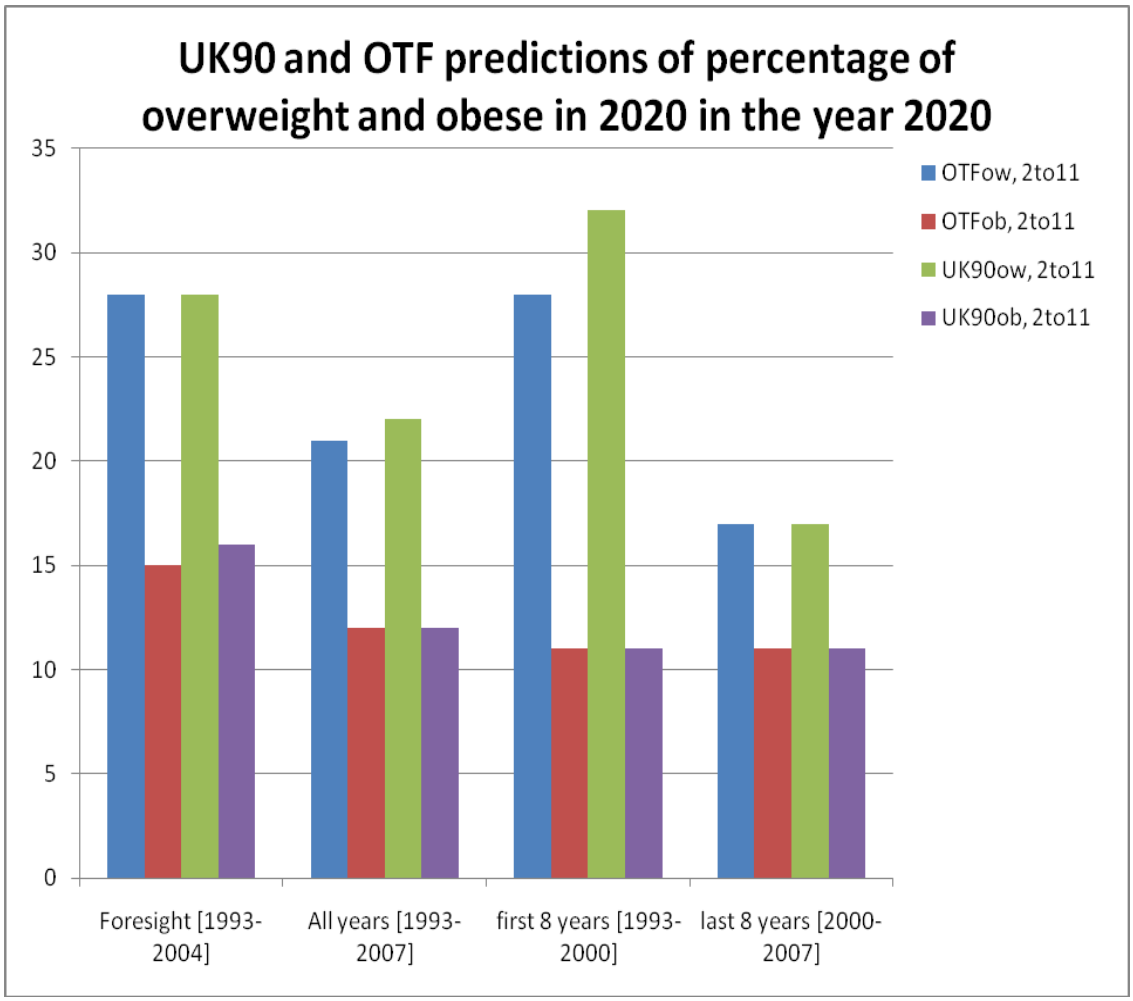

Figure 9: [Tables 1 and 2] predictions of the percentage of overweight and obese children in 2020

Figure 9 summarises the predicted levels of overweight and obese made using all the available data [columns 5,6,7,8] are all lower than their Foresight equivalents [columns 1,2,3,4].

The predicted levels of overweight based on the last eight year's data are significantly lower than the same levels predicted from the first eight years – obesity levels are comparable.

6.2 Age groups 2-11 and 12-19 by sex

For both age groups {2to11, 12to19} and BMI classifications {UK90 and OTF} the 2020-predicted percentages of overweight and obese for all years [1993-2007] and the last eight years [2000-2007] are lower than their equivalent values as predicted by the original Foresight study. In the following figures this statement corresponds to columns 5,6,7,8 and 13,14, 15,16 being less than columns 1,2,3,4 respectively.

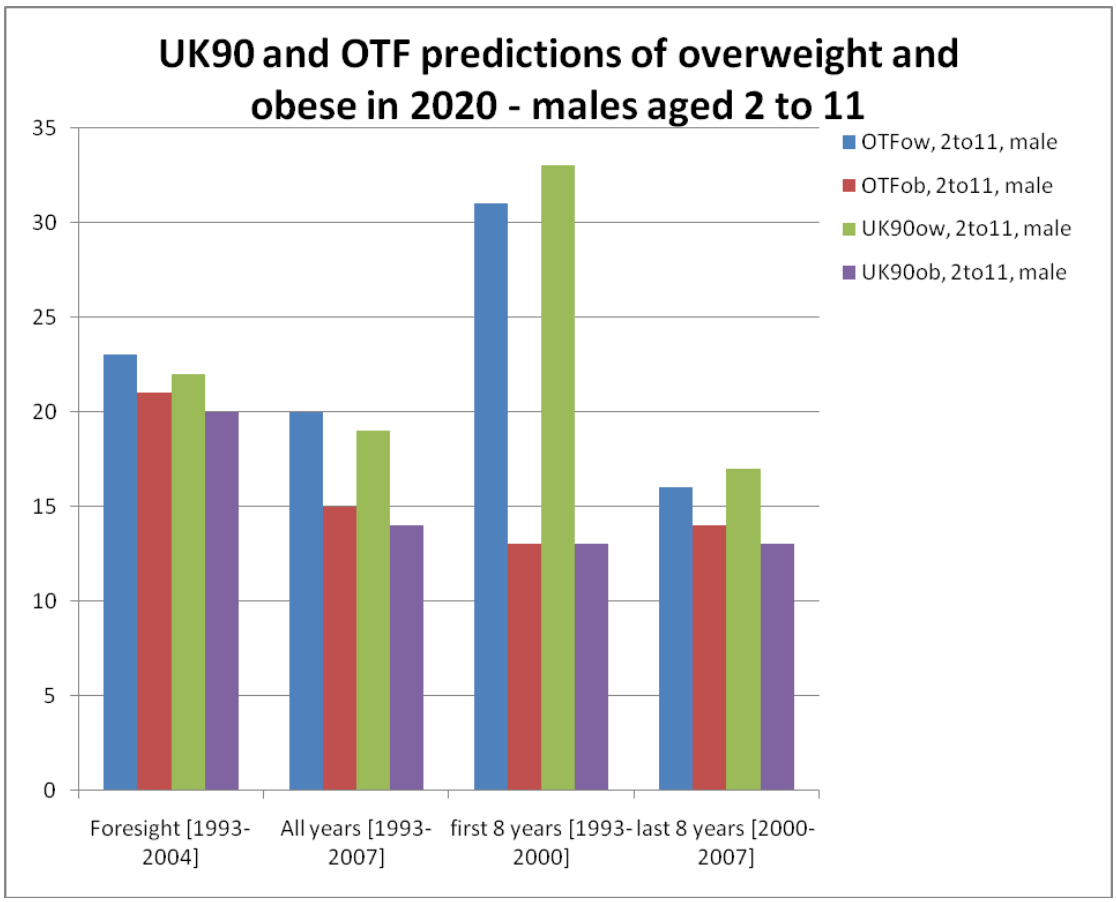

Figure 10: [Tables 3 and 5] predictions of the percentage of overweight and obese in 2020– males aged 2-11

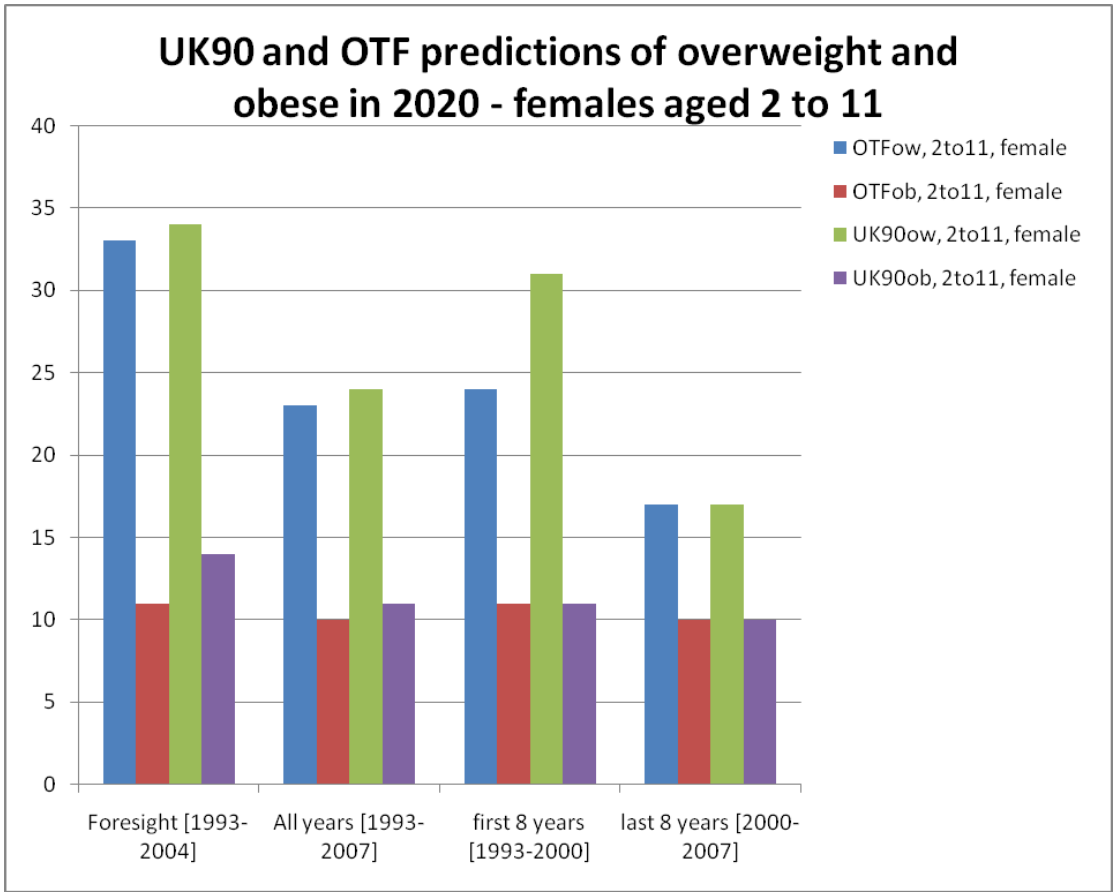

Figure 11: [Tables 3 and 5] predictions of the percentage of overweight and obese in 2020– females aged 2-11

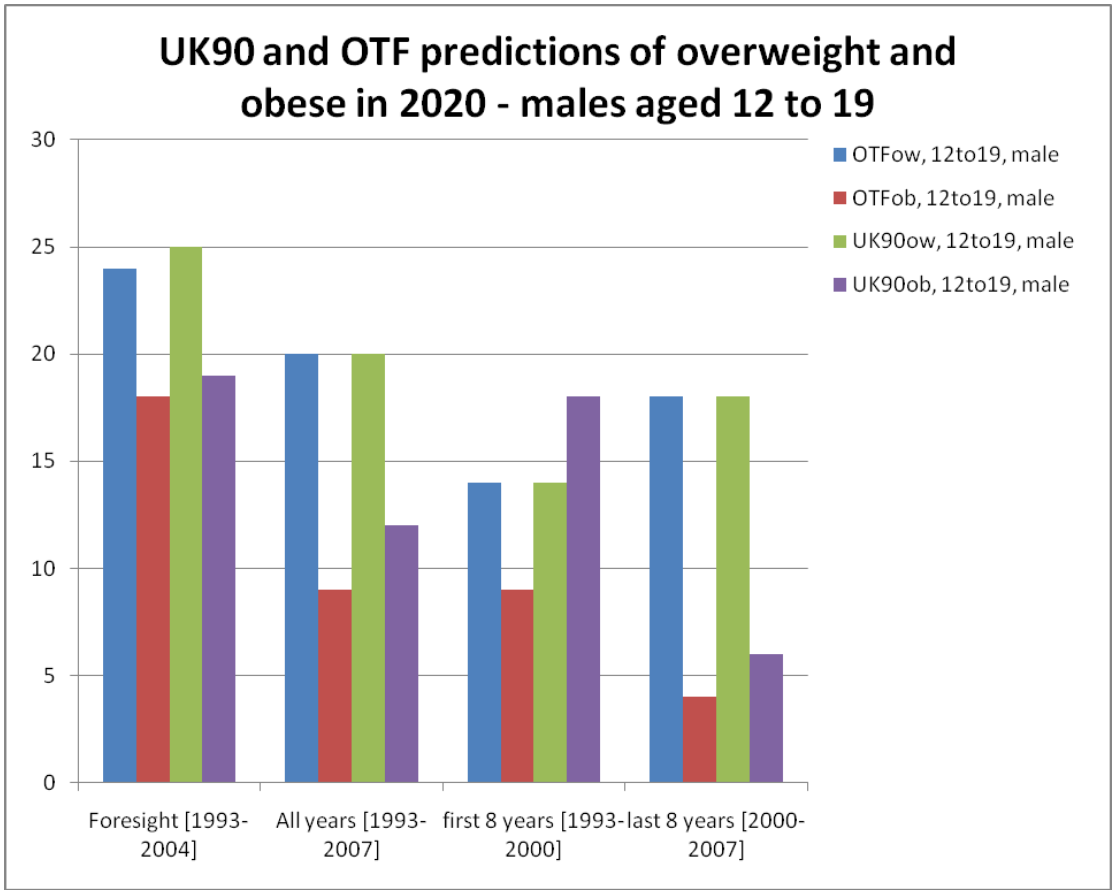

Figure 12: [Tables 4 and 6] predictions of the percentage of overweight and obese in 2020– males aged 12-19

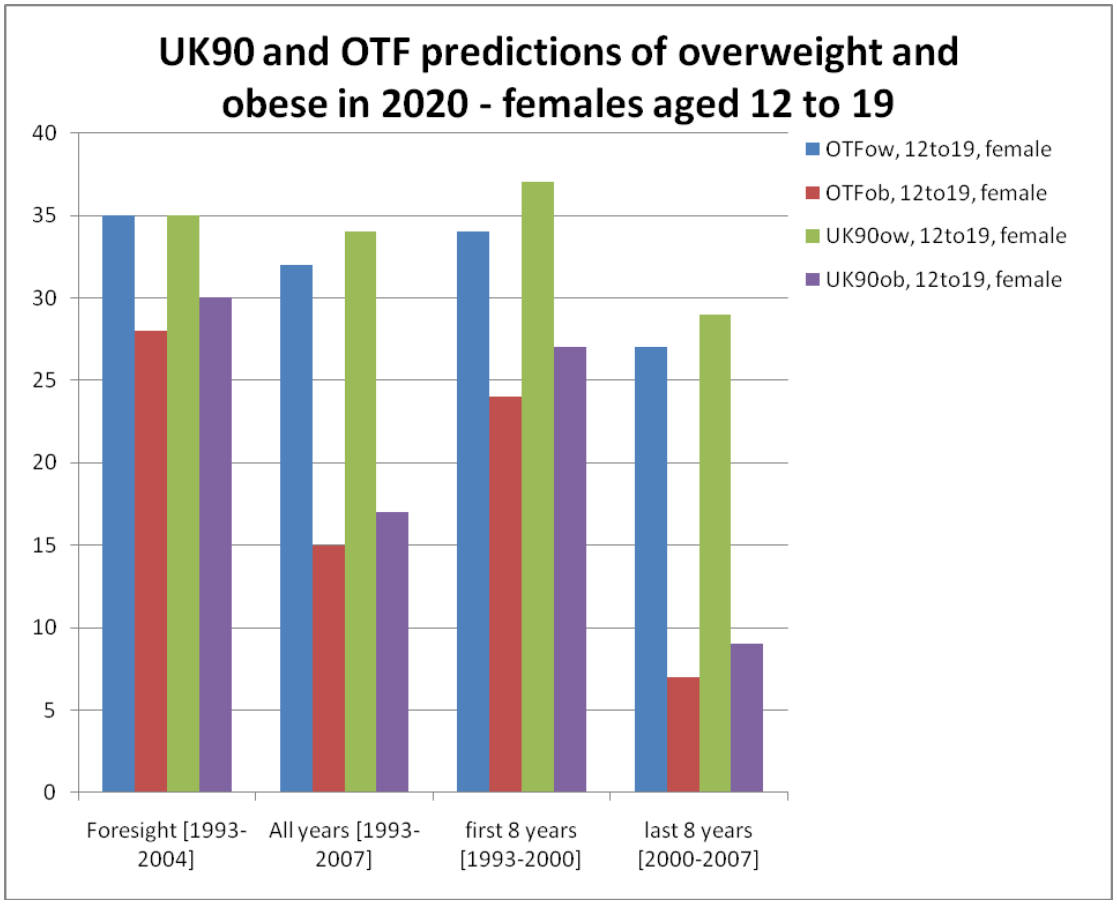

Figure 13: [Tables 4 and 6] predictions of the percentage of overweight and obese in 2020– females aged 12-19

6.3 Possible reasons for the apparent reductions in the prevalence of overweight and obese

The 2-11 age group shows a significant drop in the predicted prevalence of overweight; the 12-19 age group roughly maintains the percentage of overweight while significantly reducing the predicted prevalence of obese, but why?

These data cannot themselves provide an answer to the question as to why these rates are falling but it is of interest at least to enumerate the possibilities. There are essentially three: changes in food intake, changes in energy output, and cohort effects. It may be that the first two play a role and it would be of interest to look for supporting evidence as to its likely significance. This requires further work.

Cohort effects will certainly be present. For example, it could easily be the case that in recent successive years the younger members of the 2-11 age group might have reduced numbers of overweight while the older members with higher proportions of overweight move out of the group. This effect, if present, would seem to be less potent for the obese group.

A similar mechanism could operate to account for the reduction in the percentage of obese in the 12-19 age group. The relative youngsters coming into the group from the 2-11s are roughly constant over the years. If the distribution of the obese within the age group is weighted towards the older members then one would observe a fall in obesity prevalence as time goes by. In 2007, for example, this is true for males where there are roughly 50% more obese amongst the 16 to 19s compared to the 12 to 15s and not true for females where there are 50% more obese amongst the 12 to 15s compared to the 16 to 19s.

It may be that there are child-specific reasons for the changes but it would be wrong to imagine that the reductions in the rates of growth in obesity are confined to children. The next section discusses this point in the light of similar recent data and predictions for the whole population.

At some point it is inevitable that the prevalence of overweight and obesity in the child population will begin to level out in part due to the population reaching saturation (assuming a static environment) and in part due to action taken to counter this trend. The results presented here would suggest strongly that that process has started. However for us to be able, confidently, to identify that this is happening and is continuing to happen reliable data for large representative samples of the population must continue to be obtained and analysed. Experience from the impact of other public health interventions demonstrates that, and although there can be fairly immediate benefits, those benefits are not necessarily evenly spread throughout the population by gender, ethnicity, socio-economic status (SES) and age, and thus, all these need to be considered in the monitoring of these population trends.

Appendix A UK90 and OTF BMI cuts

age [years]	male ob	male ow	female ob	female ow
2	20.4	18.5	20.0	18.1
3	19.8	18.0	19.6	17.6
4	19.4	17.5	19.6	17.5
5	19.3	17.4	19.7	17.4
6	19.7	17.5	20.2	17.6
7	20.3	17.7	21.1	18.1
8	21.3	18.2	22.0	18.6
9	22.3	18.7	23.1	19.3
10	23.3	19.3	24.1	20.0
11	24.4	20.0	25.1	20.7
12	25.4	20.7	26.1	21.5
13	26.3	21.5	27.0	22.3
14	27.2	22.3	27.8	23.0
15	28.0	23.0	28.5	23.6
16	28.8	23.7	29.1	24.2
17	29.4	24.4	29.6	24.6
18	30.0	25.0	30.0	25.0

Table 1: UK90 BMI cuts

age[years]	male ob	male ow	female ob	female ow
2	20.0	18.3	19.8	18.0
3	19.5	17.8	19.3	17.5
4	19.2	17.5	19.1	17.2
5	19.2	17.4	19.1	17.1
6	19.8	17.5	19.6	17.3
7	20.6	17.9	20.5	17.7
8	21.6	18.4	21.6	18.3
9	22.7	19.1	22.8	19.0
10	24.0	19.8	24.1	19.8
11	25.1	20.5	25.4	20.7
12	26.0	21.2	26.7	21.7
13	26.8	21.9	27.8	22.5
14	27.6	22.6	28.6	23.3
15	28.3	23.3	29.1	23.9
16	28.9	23.9	29.4	24.3
17	29.4	24.4	29.7	24.7
18	30.0	25.0	30.0	25.0

Table 2: OTF BMI cuts

Appendix B UK90 and OTF distributions by sex and age

Appendix B.1 UK90 distributions for boys aged 2-11, 12-19

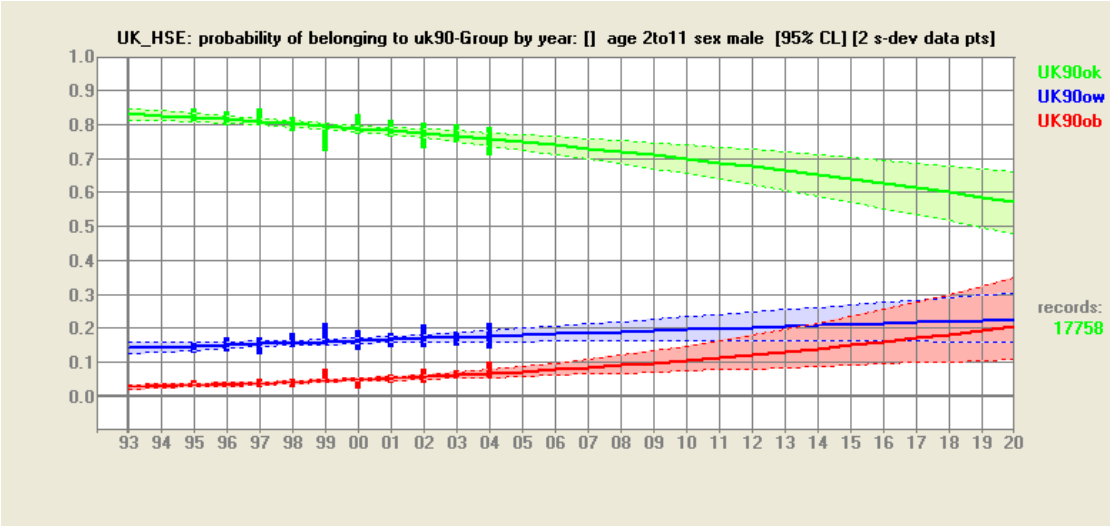

Figure15: males aged 2-11, predicted UK90 membership to 2020 data years [1993-2004]

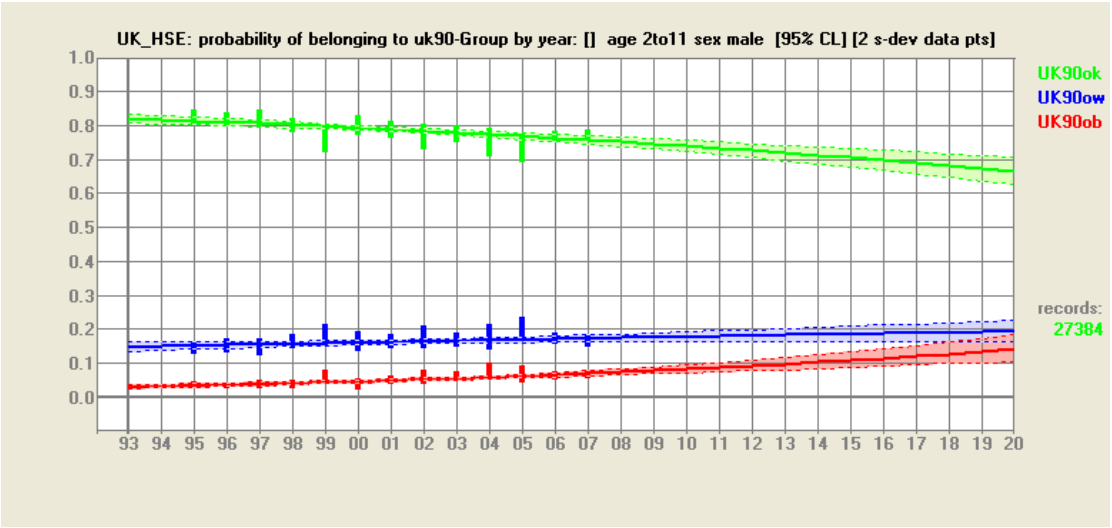

Figure16: males aged 2-11, predicted UK90 membership to 2020 data years [1993-2007]

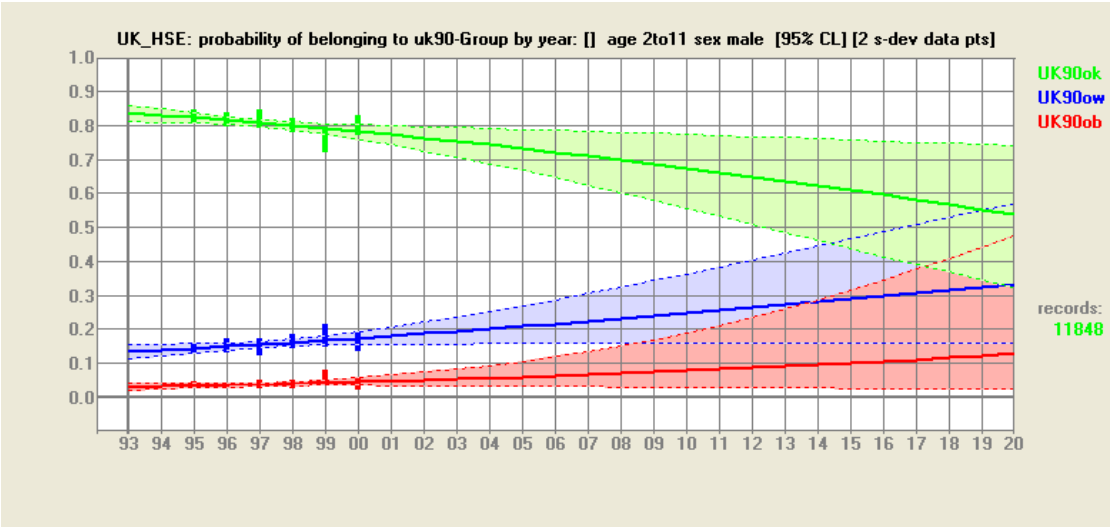

Figure 17: males aged 2-11, predicted UK90 membership to 2020
data years [1993-2000]

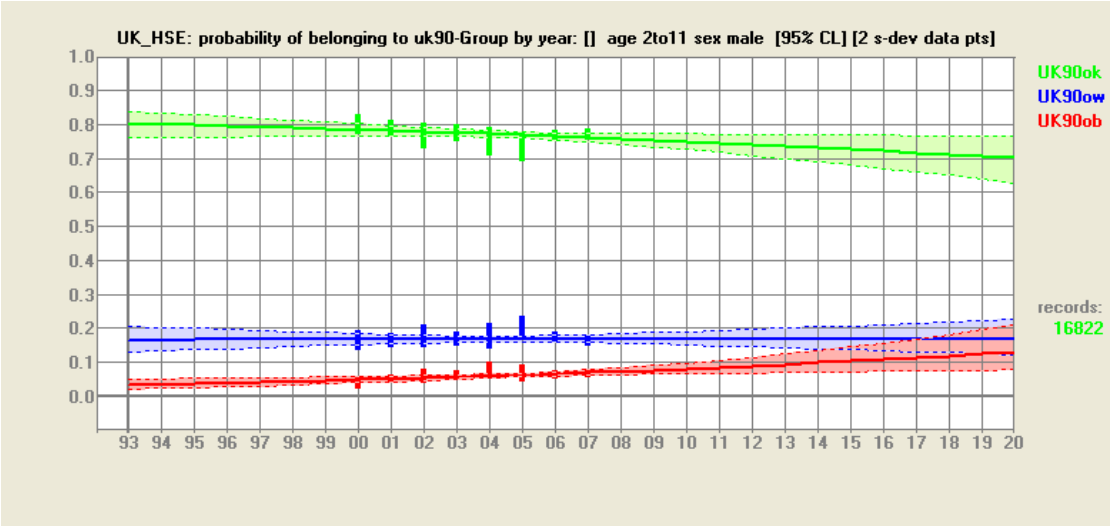

Figure 18: males aged 2-11, predicted UK90 membership to 2020
data years [2000-2007]

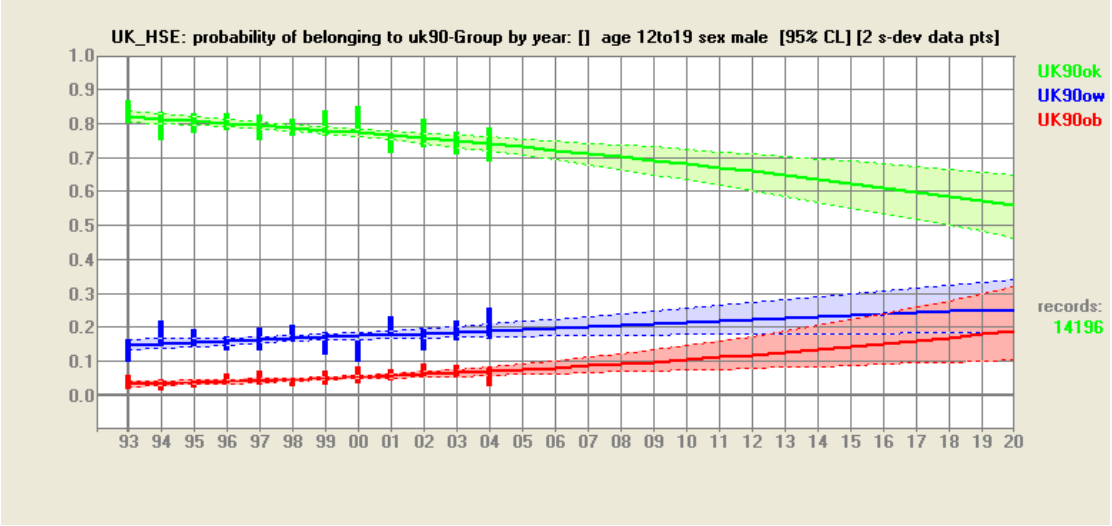

Figure 19: males aged 12-19, predicted UK90 membership to 2020 data years [1993-2004]

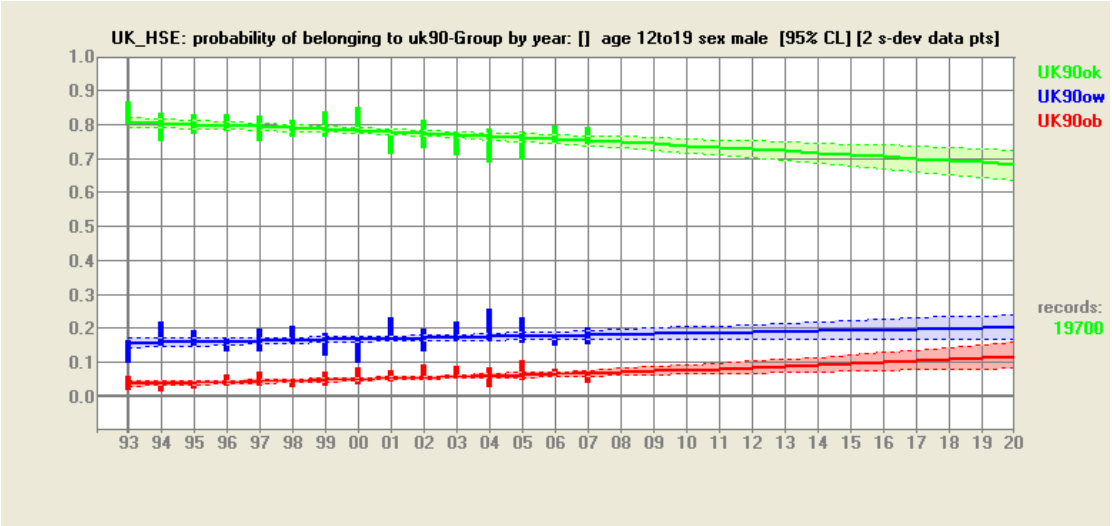

Figure20: males aged 12-19, predicted UK90 membership to 2020 data years [1993-2007]

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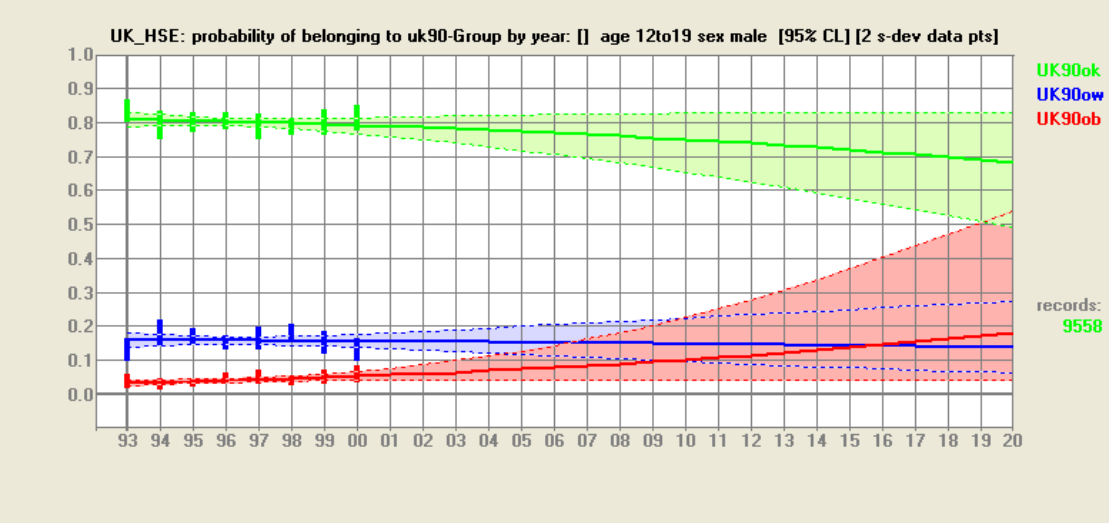

Figure 21: males aged 12-19, predicted UK90 membership to 2020 data years [1993-2000]

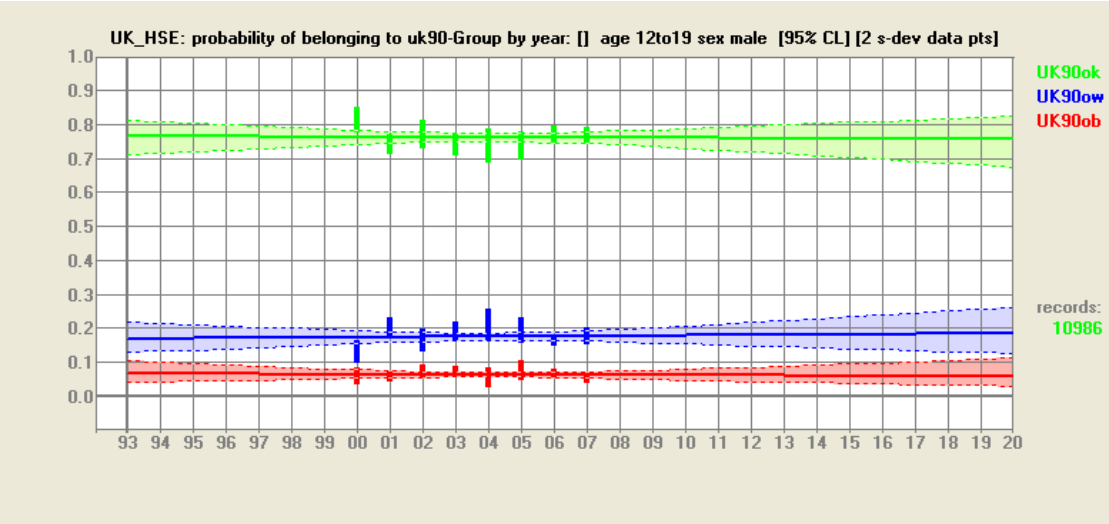

Figure22 males aged 12-19, predicted UK90 membership to 2020 data years [2000-2007]

Appendix B.2 UK90 distributions for girls aged 2-11, 12-19

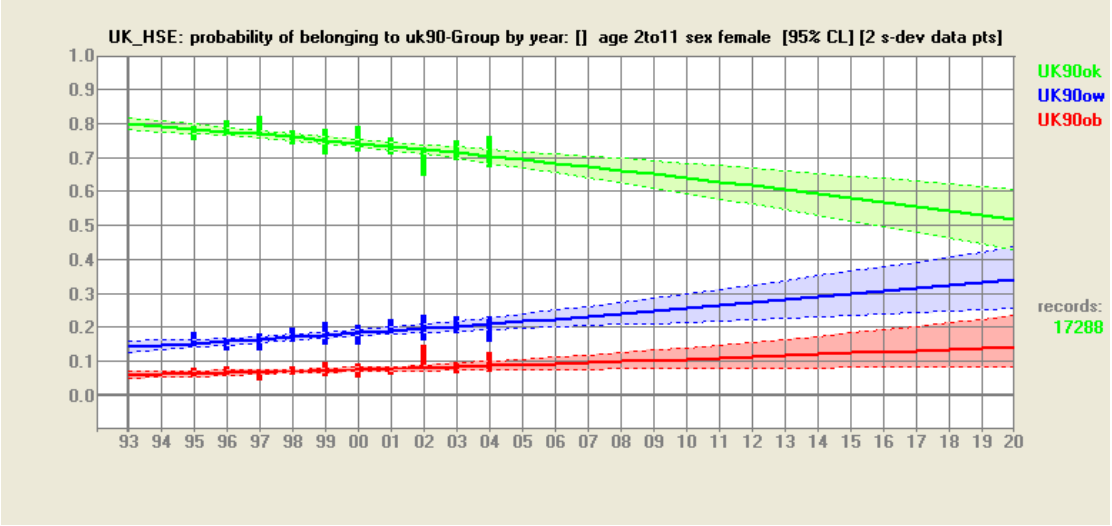

Figure23: females aged 2-11, predicted UK90 membership to 2020 data years [1993-2004]

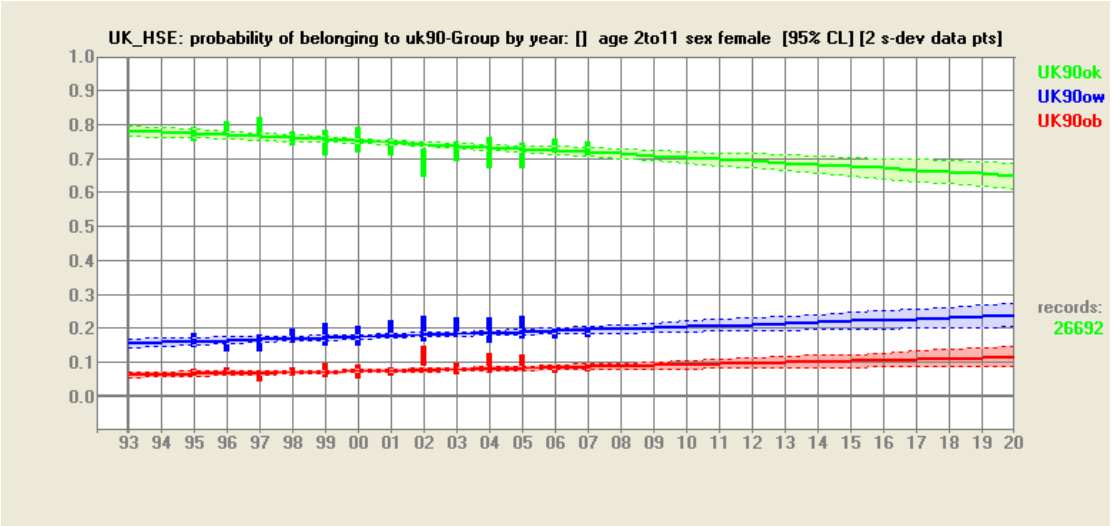

Figure24: females aged 2-11, predicted UK90 membership to 2020 data years [1993-2007]

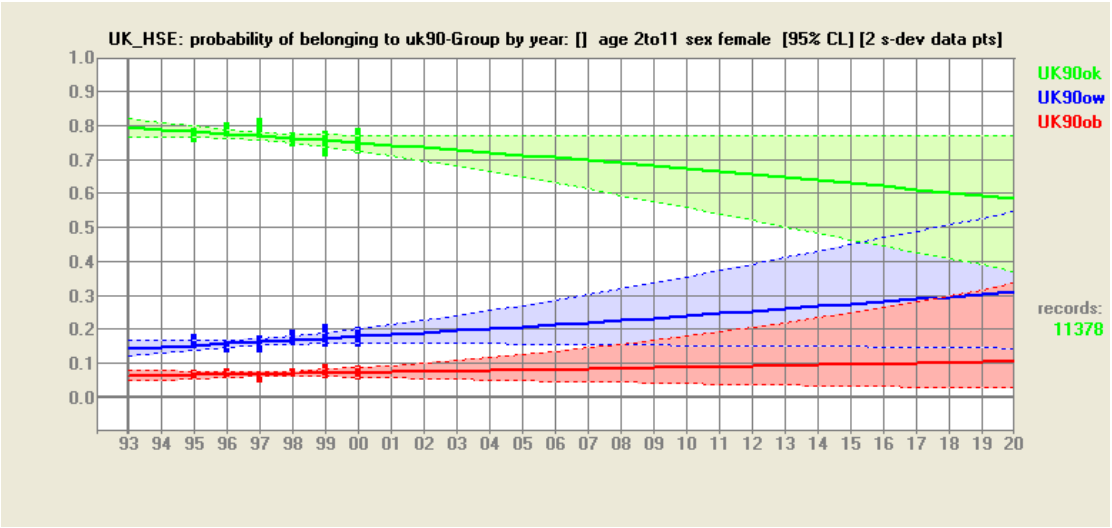

Figure25: females aged 2-11, predicted UK90 membership to 2020 data years [1993-2000]

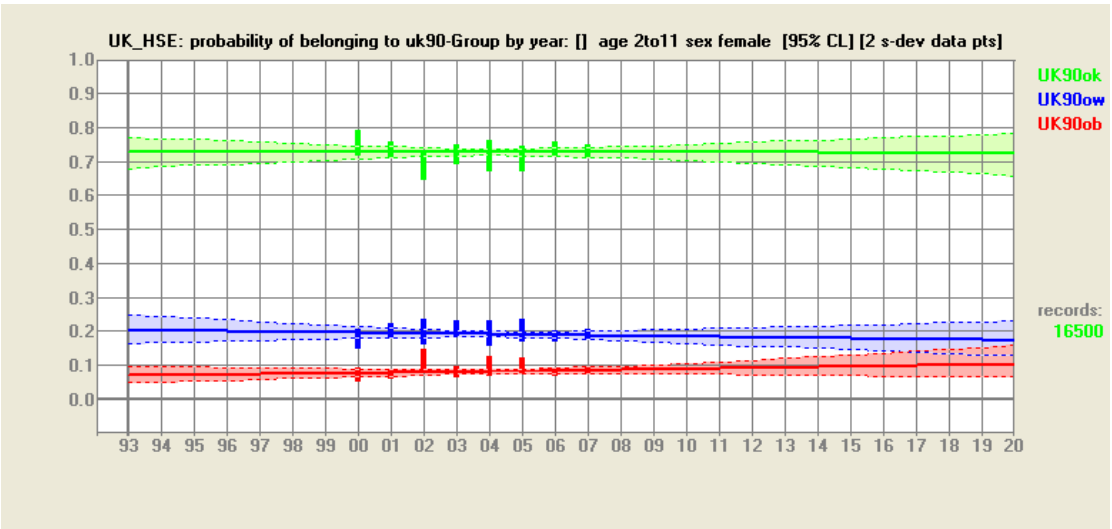

Figure26: females aged 2-11, predicted UK90 membership to 2020 data years [2000-2007]

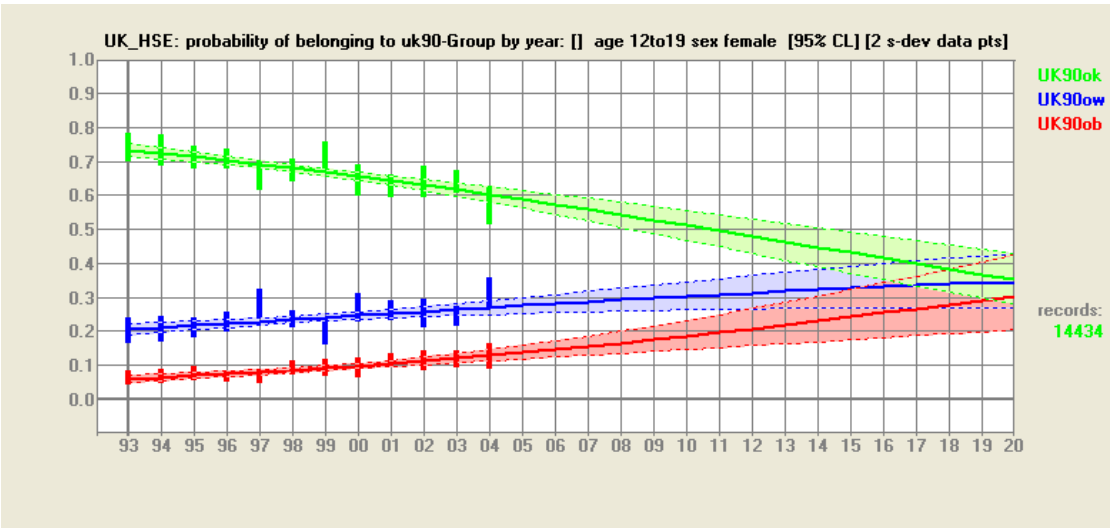

Figure27: females aged 12-19, predicted UK90 membership to 2020
data years [1993-2004]

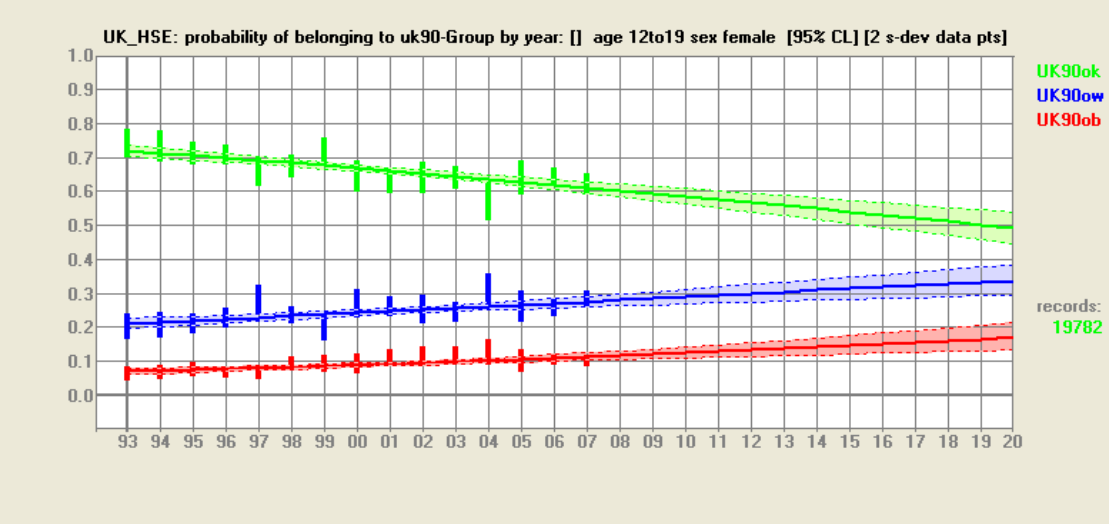

Figure28: females aged 12-19, predicted UK90 membership to 2020
data years [1993-2007]

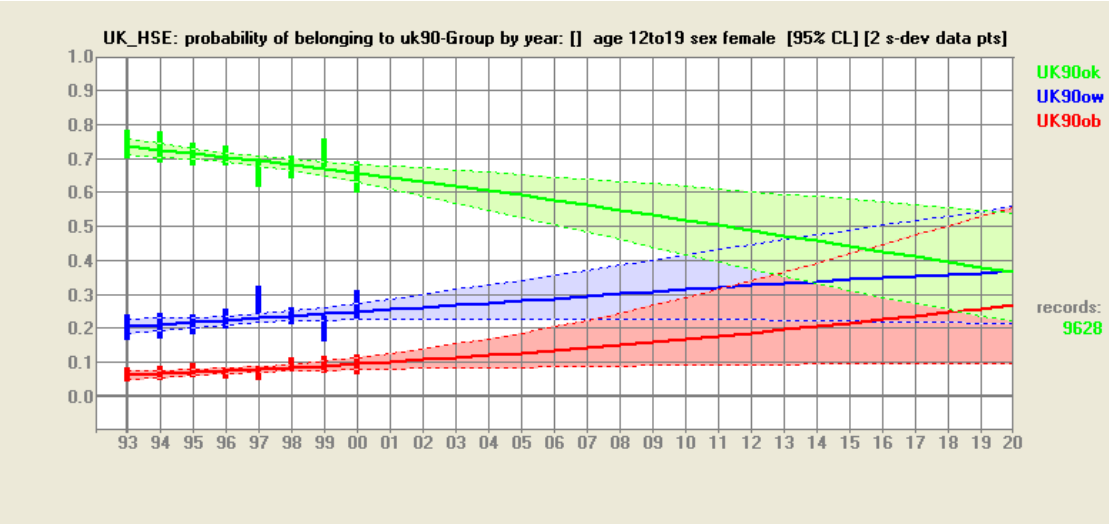

Figure29: females aged 12-19, predicted UK90 membership to 2020
data years [1993-2000]

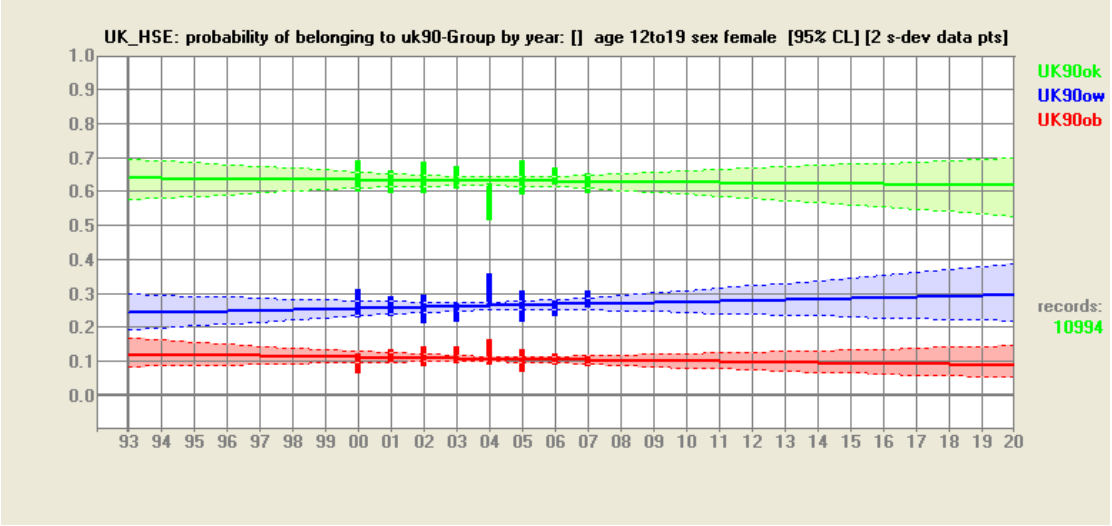

Figure30: females aged 12-19, predicted UK90 membership to 2020 data years [2000-2007]

Appendix B.3 OTF distributions for boys aged 2-11, 12

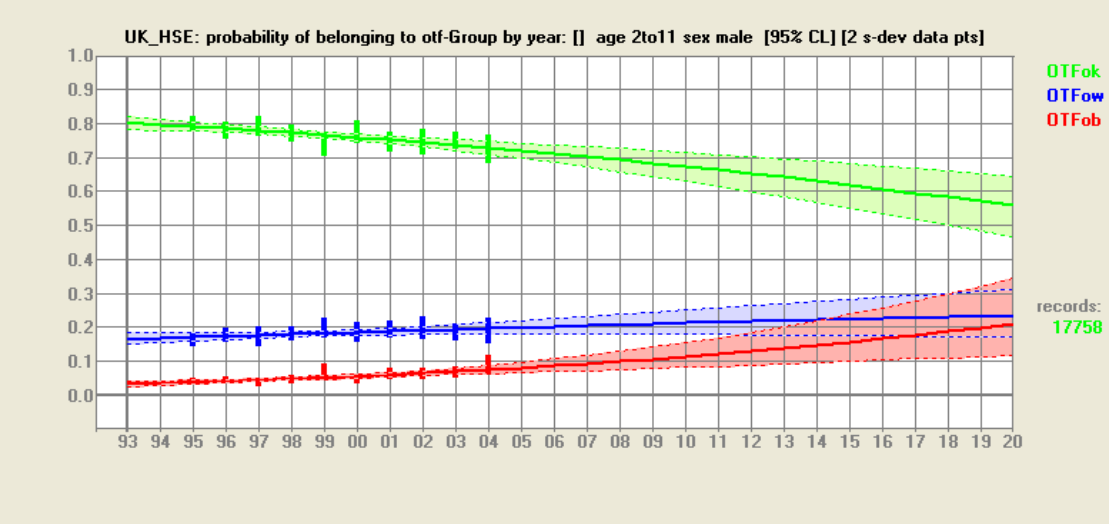

Figure 31: males aged 2-11, predicted OTF membership to 2020
data years [1993 to 2004]

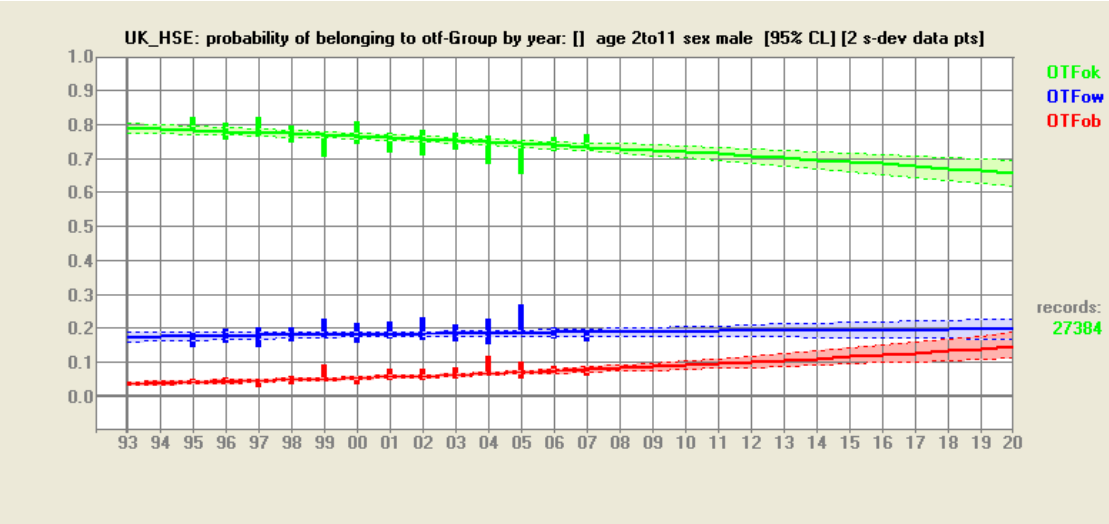

Figure 32: males aged 2-11, predicted OTF membership to 2020
data years [1993 to 2007]

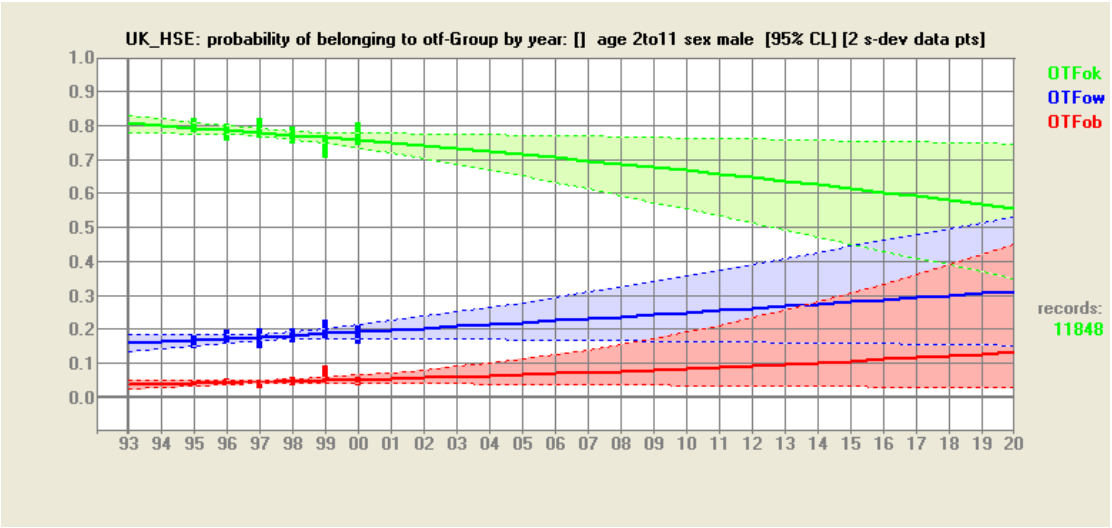

Figure 33: males aged 2-11, predicted OTF membership to 2020
data years [1993 to 2000]

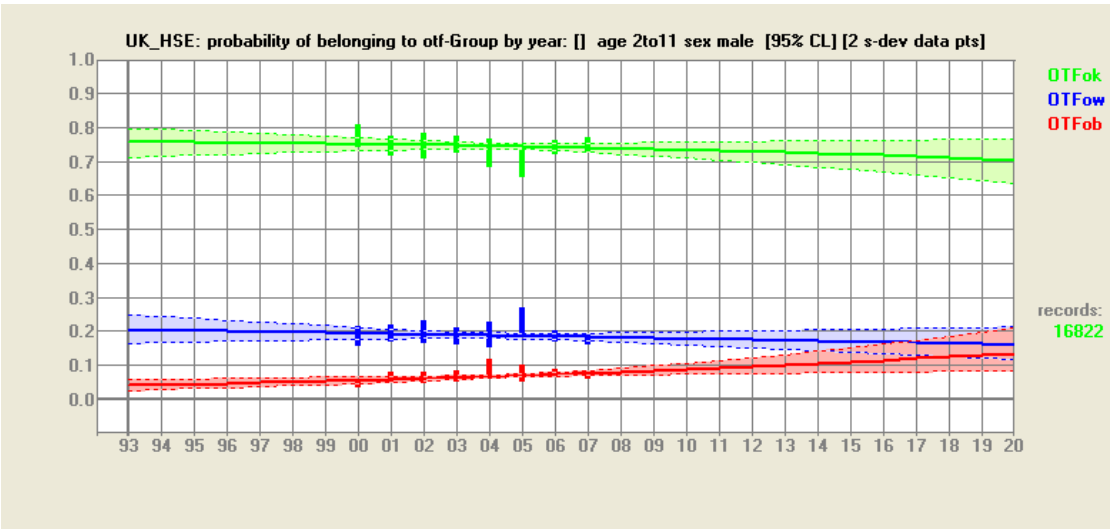

Figure 34: males aged 2-11, predicted OTF membership to 2020
data years [2000 to 2007]

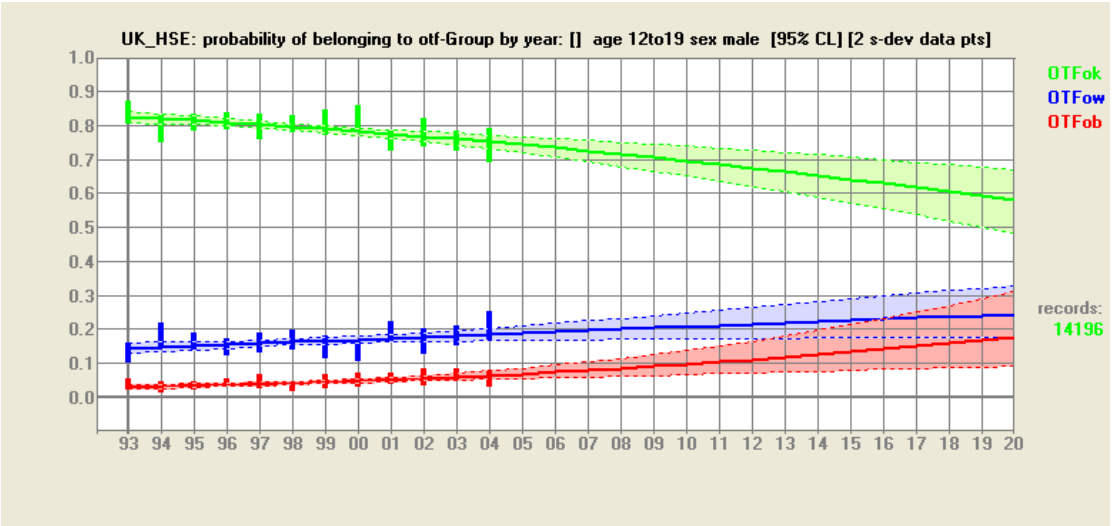

Figure 35: males aged 12-19, predicted OTF membership to 2020
data years [1993 to 2004]

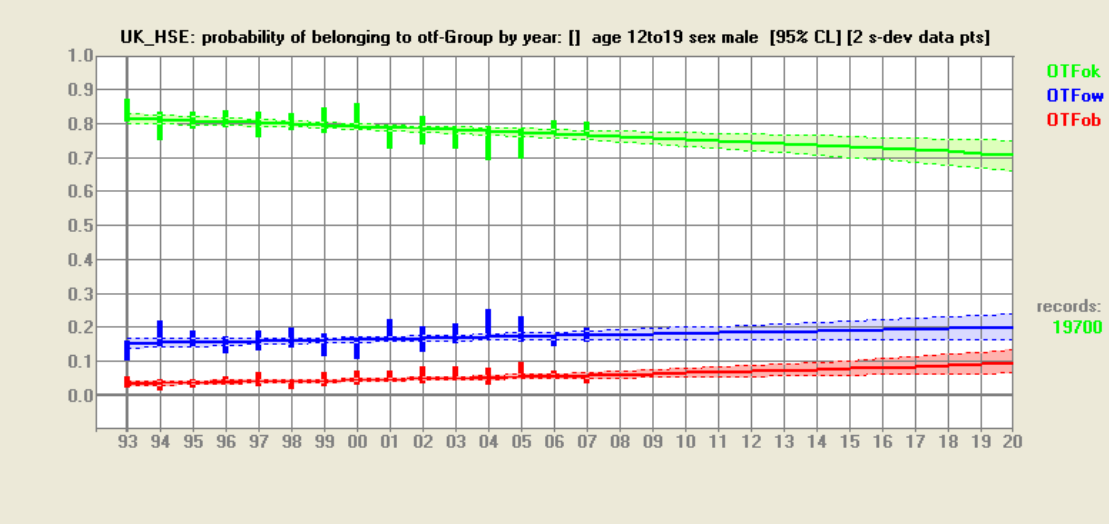

Figure 36: males aged 12-19, predicted OTF membership to 2020
data years [1993 to 2007]

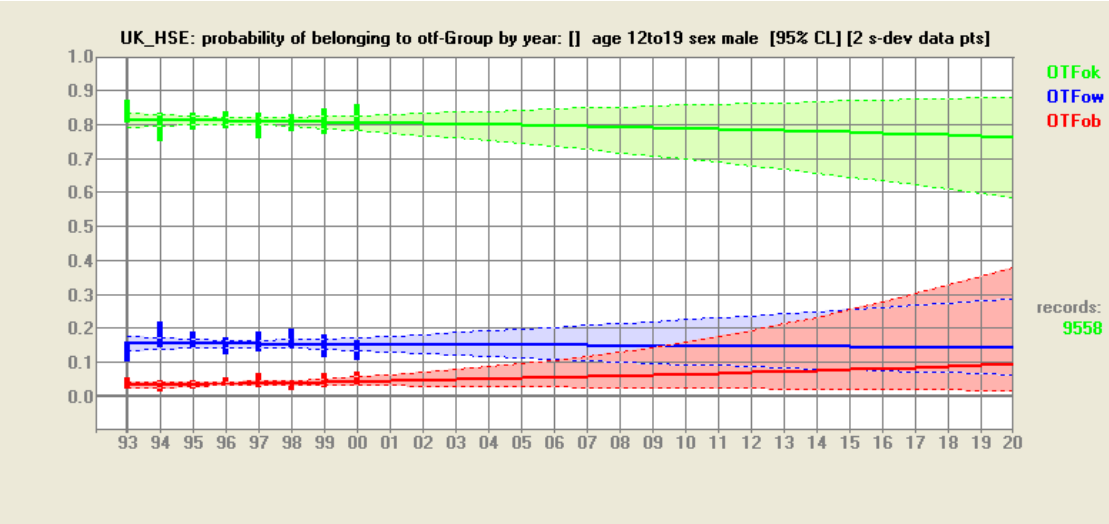

Figure 37: males aged 12-19, predicted OTF membership to 2020
data years [1993 to 2000]

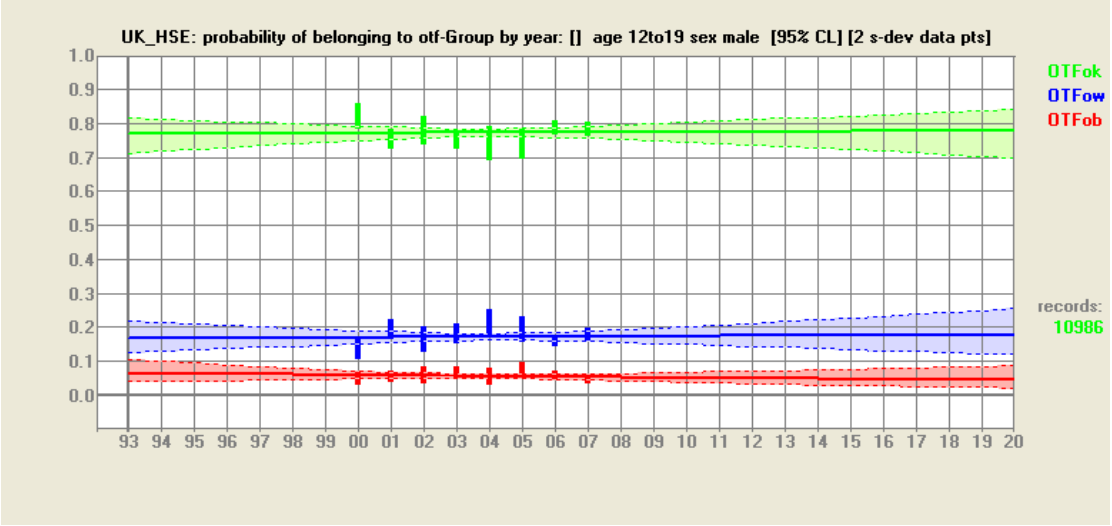

Figure 38: males aged 12-19, predicted OTF membership to 2020

data years [2000 to 2007]

Appendix B.4 OTF distributions for girls aged 2-11, 12-19

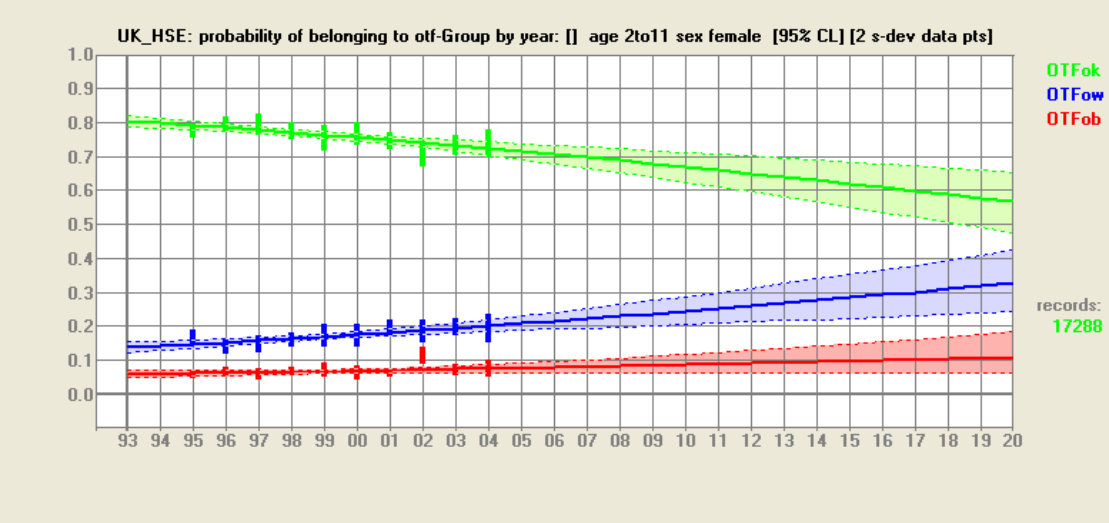

Figure 39: females aged 2-11, predicted OTF membership to 2020 data years [1993 to 2004]

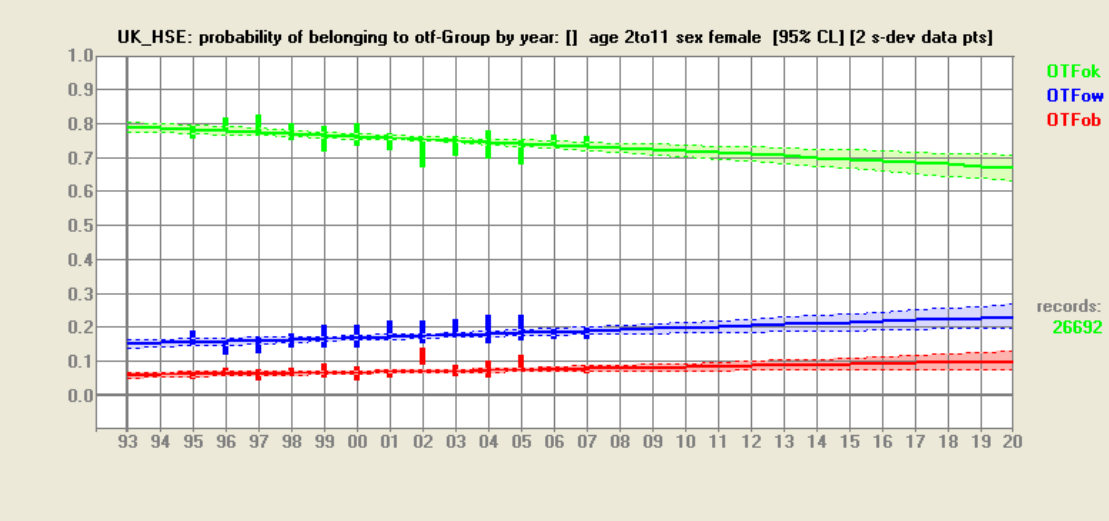

Figure 40: females aged 2-11, predicted OTF membership to 2020 data years [1993 to 2007]

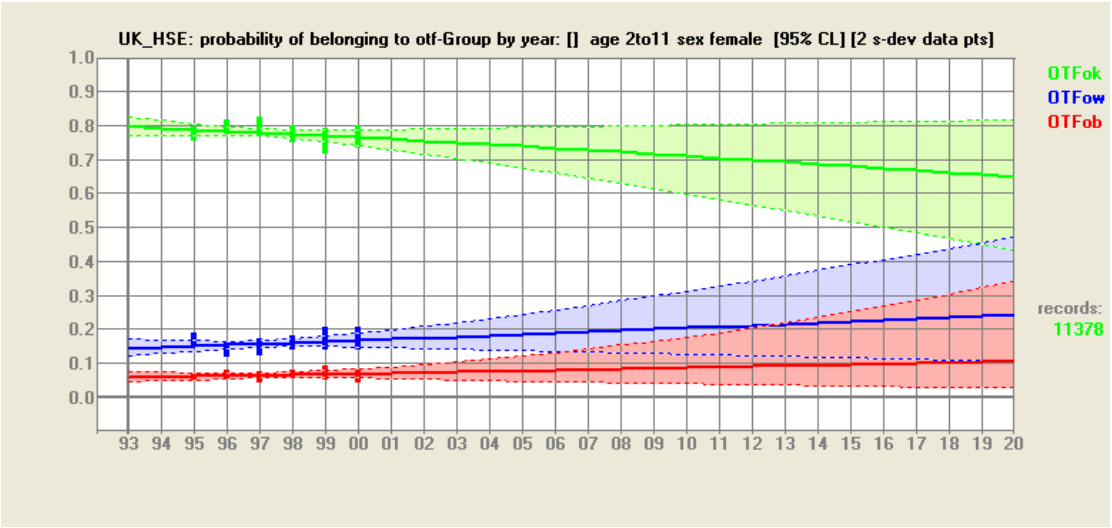

Figure 41: females aged 2-11, predicted OTF membership to 2020
data years [1993 to 2000]

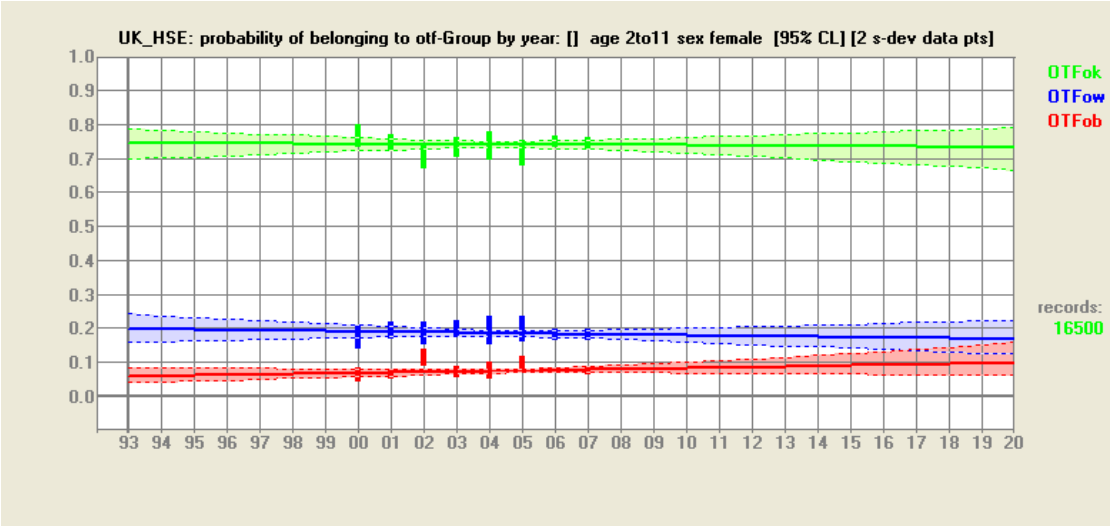

Figure 42: females aged 2-11, predicted OTF membership to 2020
data years [2000 to 2007]

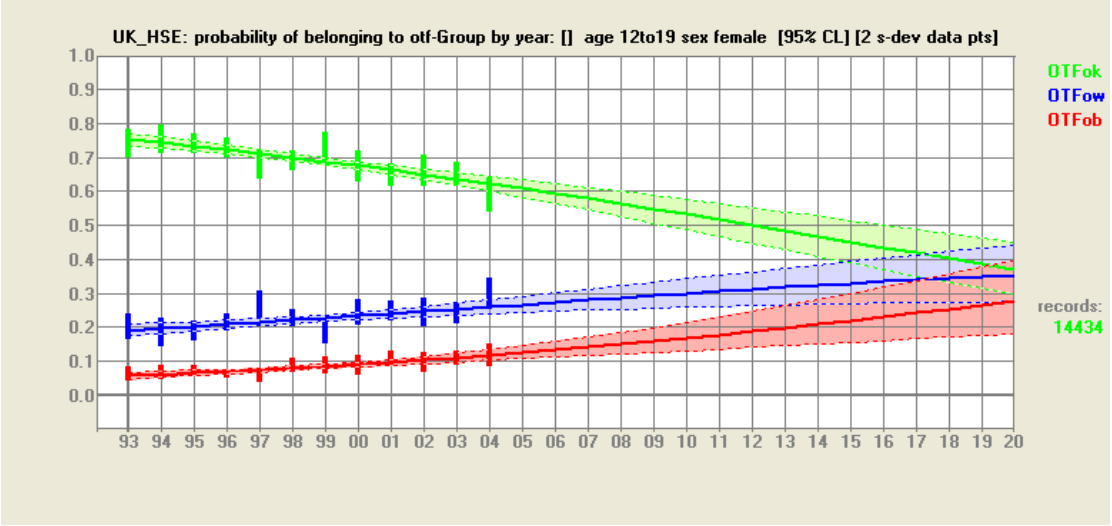

Figure 43: females aged 12-19, predicted OTF membership to 2020

data yeas [1993-2004]

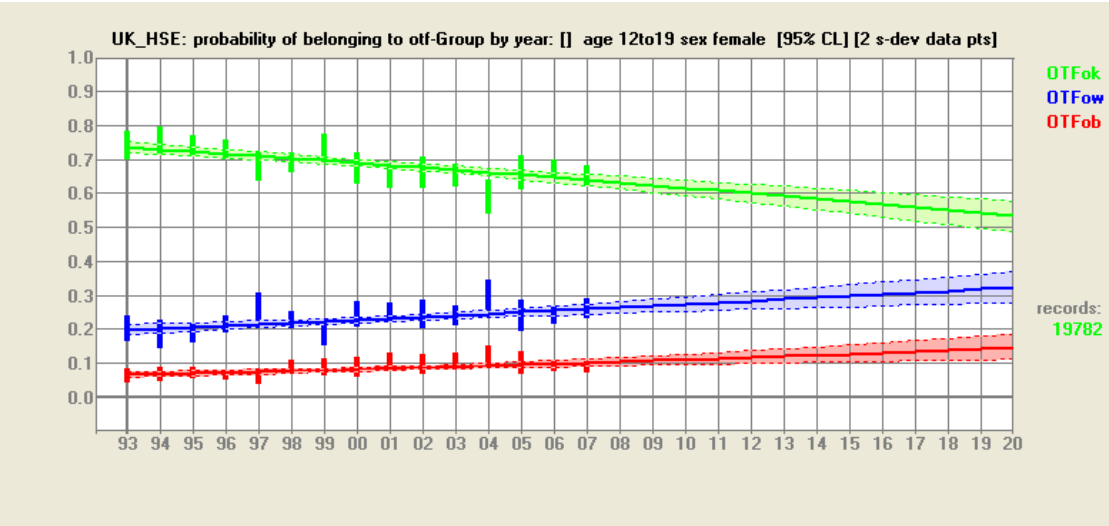

Figure 44: females aged 12-19, predicted OTF membership to 2020

data yeas [1993-2007]

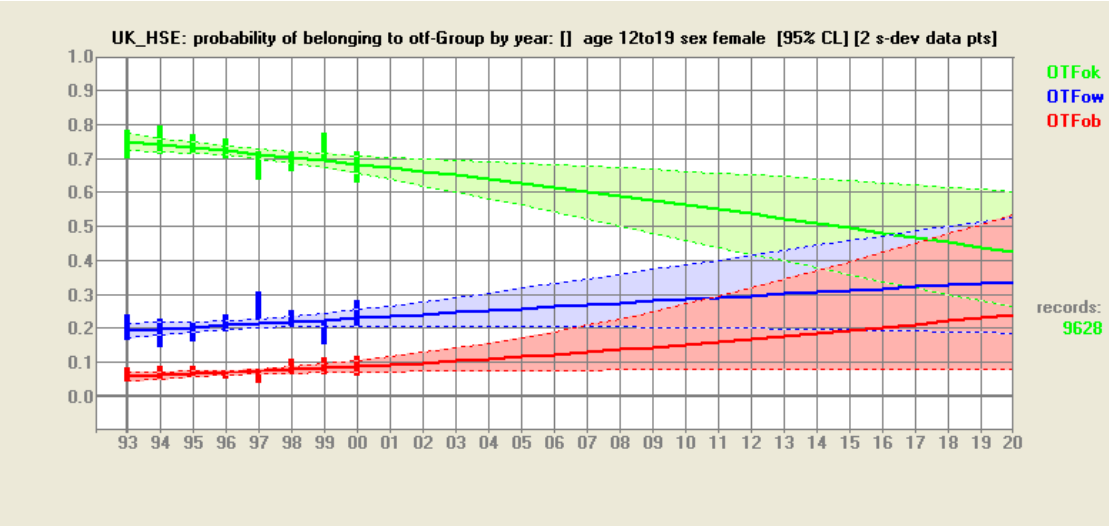

Figure 45: females aged 12-19, predicted OTF membership to 2020

data yeas [1993-2000]

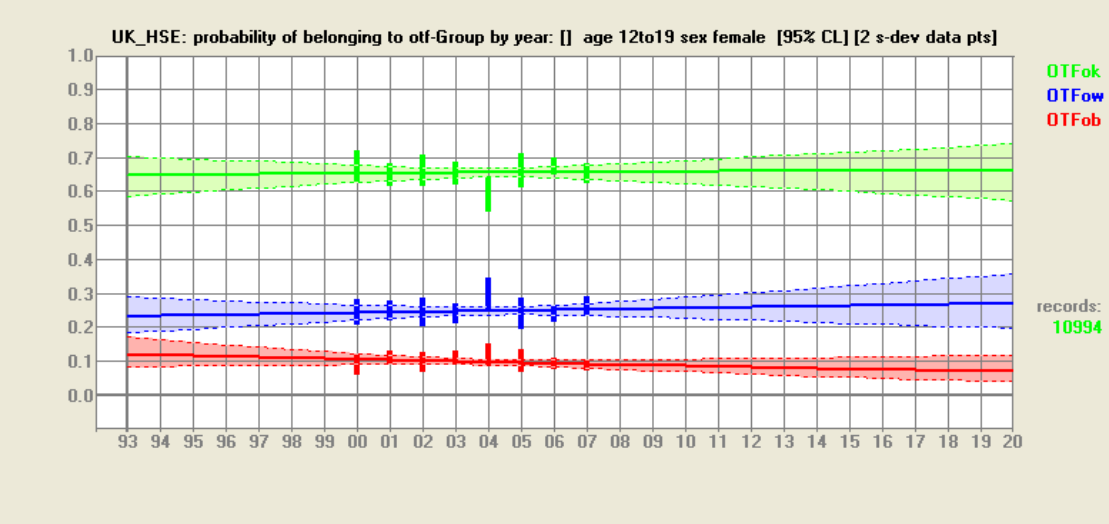

Figure 46: females aged 12-19, predicted OTF membership to 2020

data yeas [2000-2007]

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[i] McPherson K., Marsh T., Brown M. (2007), Foresight Tackling Obesity: Future Choices – Modelling Future Trends in Obesity and Their Impact on Health. Government Office for Science

[ii] Brown M., McPherson K., Marsh T. (2009). 'The Estimated Growth of Obesity Prevalence. An assessment of the impact of the most recent (2007) data from Health Survey England', Report to the Cross Government Obesity Unit (In Press)

[iii] UK90 and IOTF Obesity classifications

[iv] The UK90 cut points were calculated independently by Matin Brown and Tim Cole Tim.Cole@ich.ucl.ac.uk (private communication), Paed. Epid. & Biostats, UCL Institute of Child Health, London WC1N 1EH, UK. For any age and sex they are obtained by finding those BMI values that equate to the same percentiles as those for the BMI values of 25 and 30 for 18 year olds.